THE FOUNDRY

A Monthly Journal for all Departments of the Foundry Business

Vol. 40, No. 4 Cleveland, Ohio, April 1912 Whole No. 236

What Should a Cost System Accomplish?

A Description of Its Essential Features When Applied to Foundry Work — Various Record Sheets and Monthly Compilations

By S E Nold

SO MANY foundry cost systems have been offered from time to time, varying widely in method and detail, that it will savor of presumption to say that my method of collecting, arranging and disposing of foundry data is better than any other. As a matter of fact, nearly every foundry requires different treatment and a cost man must arrange a system to fit into the conditions as he finds them.

The cost man in a manufacturing plant is usually looked upon as the trouble man of the place. He *must* get the data and get it correctly, or all his work is a farce. Too often he fails, because he cannot get the support of the men higher up to compel those on whom he must depend for information, to supply, through avenues, he has prepared, the data he must have to get results. When the foundry manager, superintendent or foreman—whatever the title of the man in charge may be—heartily cooperates with the cost man, the result is never in doubt. And who, if not the foreman, ought to be so much interested in getting an intelligent exposition and comparison of facts about the foundry work? In addition to daily reports, the foreman should be furnished with a copy of the monthly reports, the same as furnished the management by the cost man. This will make him not only willing, but anxious to assist in having all the data shown up in the reports. This may look like dictation to the management, but it is really only a plea that the cost man be given a reasonable opportunity to make good.

No cost system can be satisfactory unless it takes care of every item of material and labor outlay and overhead charges, or if a part of a manufacturing plant, its proportionate share of overhead charges. All material and labor must be classified under a sufficient number of heads, in order that a higher or lower cost can readily be traced to particular items.

But systematizing can easily be overdone. Don't waste time on molehills when you have mountains to compute. Systems burdened with cumbrous and extended details, giving no useful information, nor contributing to means of discovering the causes that help to make an increase or decrease in the cost of the output from month to month, are like roads built and maintained at big expense, but leading to nowhere. All that can be said for them is that they are somebody's very elaborate and beautiful system.

After a cost system is installed, no matter how simple or elaborate, every detail must be religiously followed up and faithfully carried out, or failure will follow. *Everlastingly after it,* is the price of a clean cost. No system can work itself.

MATERIAL Cherry Valley Pig PRICE 16.40.
FROM M.A. Hanna & Co. Cleveland, O. FRT. 6.10
CAR NO. SHIPPED REC'D. POUNDS
ANALYSIS — SI 2.50 S .03 P .60 MN .70

USED	DATE	WEIGHT	DATE	WEIGHT	DATE	WEIGHT

Form 1-488-500-2-25-10

FIG. 1—MATERIAL CARD

Carefully - prepared printed forms are indispensable in cost work. Universal forms are seldom satisfactory, as they are sure to lack either something essential, or call for information not wanted. A new cost man who sweeps aside all that his predecessor has left over, sending printed forms to the obsolete corner, is a *bull in a china store.* Some of the most complete and desirable forms I have seen, I found among the effects of a cost man who had failed to make good. Proof that complete forms cannot produce satisfactory cost.

I have been asked to give forms that have proven satisfactory, with information how to use them. While these answered their purpose admirably where they were used, most of them would undoubtedly have to be modified to fit into another.

All forms should be made in stand-

L-409—5M—10—9—09

ORDER NO	DRAWING NO.	PATTERN NO.	PURCHASE ORDER NO.

NO. OF PIECES	DESCRIPTION

DATE ORDER ISSUED	DATE PATT. IN F'D'Y	DATE CAST	DATE SHIPPED	WEIGHT LBS.

DATE	MOLDER	HANDY MAN	HELPER	DATE	CORES	HELPER	DATE	CHIPPER

MOLDER	HANDY MAN	HELPER	CORES	CHIPPER	O. K.
EST			EST		FOREMAN

FIG. 2—RECORD CARD

ard sizes. A card half an inch too long or too wide adds unnecessary expense, and breeds profanity, as it will fit into no filing case. A list of standard sizes can be had for the asking from any firm furnishing filing cabinets and card systems. Before sending a form to the printer, be sure to mark on the copy and insist on having printed on the job a line similar to this: L-483-500-2-25-10. This would read: L, the department to be charged; 483, the form number; 500, number of cards or sheets ordered, and 2-25-10, date of order. This will tell at a glance, when your stock gets low, how long this lot has lasted without the necessity of looking up the invoice and to what department to charge the job.

The material card shown in Fig. 1 was designed for pig iron, but later was used for all kinds of foundry material. Pig, scrap, fire clay, fire brick, limestone, coke, coal, sand, seacoal, coke blacking, flour, molasses and lumber were among the materials I kept track of on these cards. All invoices for foundry material were sent to my desk and from these I filled out duplicate cards for each invoice, retaining one, and sending the other to the foundry foreman. All pig iron was ranked, each car by itself, and the car number painted on several pigs of each car. The amounts taken from each car were reported daily to the foundry office, and entered on the material cards. When a car was used, it was reported to the foundry office, and the corresponding card was footed and compared with the invoice weight. In this way errors in weighing and reporting were detected, and made the men in charge more careful. Other materials recorded on these cards were reported, daily or monthly. But how, when and by whom and where and how the materials are kept depends so much on the situation and the men in charge that a plan must be worked out for each separate plant.

All metals and cupola supplies were daily reported to the cost man on daily cupola report blanks, shown in Fig. 8. This sheet was designed by the foundry superintendent to meet his particular requirements and provided for recording valuable data, for his own use. Only special work, calling for a certain analysis, was noted on the bottom of this report.

The record card, Fig. 2, and the work card, Fig. 3, brought the order into the foundry. The record card remained in the foundry office. The work card was broken in two and the molder's half was tacked onto the pattern and the coremaker's half was tacked onto the corebox, or was given to the core boss. The molders and coremakers entered their time on their respective cards. As the jobs were completed, these work cards were brought into the foundry office, and the time was transferred to the record card.

Chipping Record

The chipping card, Fig. 4, was filled out in the foundry office from the record card, and was given to the chipping boss, and the time, if it was possible to distribute it fairly, was entered on these cards. Where there are many small pieces of many kinds, from many orders in the tumbling mills at the same time, an estimated cost placed on the record cards of each job in question, is the sensible thing to do. To spend 25 cents worth of time, trying to distribute 17 cents of cost, is *making cost*, not finding it. As fast as jobs are chipped, or if the pieces are large, as fast as pieces are chipped, they should be weighed and marked. *Mark every piece. Not* to mark them is one of the most prolific sources of error, trouble and loss. Mark them with yellow or white paint. Mark them somehow—but mark them. If there is insufficient space on a piece for a mark, wire a tag to one or more pieces of the lot, and mark the tag. I have seen so much trouble accruing from *not* doing it, that I am trying to emphasize the necessity of doing it. Mark your castings, and economize profanity, save friendships and make money for your firm. Somebody about your place ought to be able to tell how to mark them. Find the man!

In a jobbing foundry, immediate notice should be sent to the shipping

L-406-5M-10-9-09

ORDER NO.	PURCHASE ORDER NO.	ORDER NO.	PURCHASE ORDER NO.

DRAWING NO.	PATTERN NO.	DRAWING NO.	PATTERN NO.

NO. OF PIECES	DESCRIPTION	NO. OF SETS	DESCRIPTION

DATE	MOLDER'S NO.	MOLDER'S TIME	HELPER'S NO.	HELPER'S TIME	NO. MADE	DATE	MAN'S NO.	CORE TIME	HELPER TIME	NO. MADE
TOTAL						TOTAL				

FIG. 3—WORK CARD

department, or the department ordering shipments, of orders completed. In Fig. 6 is shown the daily foundry production sheet. Making up this report should be the first work of the foundry clerk in the morning. The order of the work would be something like this: Bring the molders' work cards and clock cards into the office. Check the work cards against the clock cards, and see that they agree. Enter all the work cards, containing time for the previous day, on the production sheet and note the number of pieces molded and molders' clock numbers. If a piece is partly molded, but none finished that day, mark *X* in *NF* (not finished) column, following the description.

As the weight and bad castings cannot be ascertained until the chipping and cleaning is done, a few of these partly finished sheets must be sent to those who need the information at once of what has been made. A number of sheets can be made at one writing by using carbon paper, and the number to be made and whom sent, must be determined by the management. These sheets should be on the desks where needed, an hour after work is begun in the morning. Those in charge of the work passing through the shops need this information as early as it is possible to get it to them. Two sheets must be retained in the foundry office until the weights and bad castings are filled in; then one copy is sent to the cost man and the other is retained.

A careful study of this sheet will show it to be a complete exposition of the progress of the work on the floor, the day's production and distribution, and the men producing each piece, and their failures. The time and material necessarily must be taken care of on other sheets or forms. On the daily foundry time sheet, Fig. 7, all foundry time is entered daily by the foundry clerk, after the production sheet is disposed of. All foundry clock cards should be classified by marking them as suggested by the numbers from 100 to 129 on the foundry time sheet. All cards marked 110 would indicate molders; 115, coremakers, and so on through the list. It is comparatively easy to fill out these foundry time sheets by this method. These sheets are daily sent to the cost man. Checking these against the payroll at the end of the month, verifies the time and gives him an intelligent plan of distributing the time.

The condemnation report is shown in Fig. 5. When a piece is found to be defective or wrong, whether the discovery is made in the foundry, machine shop, erecting room or store room, a condemnation report should at once be made out. This should clearly state the description of the piece, what the defect is or the reason for rejection, and if possible, who is responsible, and the hours of machine time before the error was discovered. This report carries with it an order for a replacement, unless instructions to the contrary are given. The foundry superintendent or foreman should *OK* all condemnations made in the foundry and the superintendent or manager, those made outside of the foundry. This is only a suggestion, but the propriety of it can be appreciated. These condemnation reports are used by the cost man in making up the bad castings account for the month. The same condemnation reports can be used for all errors on all kinds of material throughout the plant, where a machine shop and other departments are in connection with the foundry.

REPLACE YES / NO — CONDEMNATION REPORT

ORDER NO	DRAWING NO	PATTERN NO	PURCHASE ORD
NO PCS — DESCRIPTION		MATERIAL	WEIGHT

TO REPLACE PIECE REJECTED — TOTAL LOSS Yes No

Because of: Defective Casting; Error in Drawing; Error in Pattern; Error in Machine Shop; Broken in Handling; OR

If not state briefly where it can be used

MACHINE TIME 191

HRS	OPR.	
		FOREMAN
		SUPT

FIG. 5—CONDEMNATION REPORT

Form L 410-1M-10-12-10

ORDER NO	DRAWING NO.	PATTERN NO.	PURCHASE ORDER
NO. PCS. DESCRIPTION			MARK CASTINGS

CHIPPERS			CLEANERS			GOOD CSTGS.	
DATE	CLOCK	HRS	DATE	CLOCK	HRS	NO	WEIGHT
						BAD CASTNGS	
						NO.	WEIGHT

FIG. 4—CHIPPING CARD

Foundry Report

A complete foundry report is made up at the end of each month from the data collected, most of it daily, and the balance at the end of the month. How best to summarize the material used depends so much on where it is stored, how it is transported, what the facilities are for weighing, and who has charge of it, that it seems worse than foolish to attempt to give general instructions that would be of any value. *Use common sense methods*, but by all means get a report on everything used. Check your material cards carefully each month with the stock on hand, wherever it is possible to do so. See to it that every bin and every package or lot, wherever it is possible to do so, is plainly marked to indicate what it contains. Time

191___

DAILY (IRON / BRASS / STEEL) FOUNDRY PRODUCTION

PURCHASE ORDER NO	ORDER NO	DRAWING NO.	PATTERN NO.	PIECES MOLDED NO.	PIECES MOLDED DESCRIPTION	GOOD CASTINGS WEIGHT AND DISTRIBUTION NO.	MACHINES	FDY. R	SHP. R	BAD CASTINGS NO.	BAD CASTINGS WEIGHT	CLOCK NO.

FOUNDRY CLERK

FIG. 6—DAILY FOUNDRY PRODUCTION SHEET

and money will be saved by following this procedure.

Collect all metals as shown in Table I, and carry out the cost at the purchase price, plus the freight. The total pounds of metals will represent the cupola charge for the month. It will be noted that part of the metals in this report were melted in an air furnace, but the principle is the same as if all had been melted in cupolas, except that additional supplies for melting are introduced. It is best, however, to make separate reports, as the cost of producing air furnace iron is not the same as for cupola iron.

Referring to the item, 249,700 pounds Our Scrap, it will be noted that it is entered at the same price as Bought Scrap, namely, $14.25. On the other hand, the amount of gates and surplus and bad castings, which have been returned, and for which we have taken credit at the same price, amounted to only 184,126 pounds. As it seems a common practice to make no charge for gates and surplus added to the charge, and take no credit for gates and surplus returned, I call attention to the above figures. What would that have done to the cost if I had followed that plan? Charge everything you use, and take credit for everything you get back, is a rule that will keep you straight.

The item of loss, as here found, will need explanation, as it marks a new departure in foundry cost. All foundrymen know how difficult it is to get even an approximately correct account of the gates and surplus from day to day. Especially is this true when part of the castings are very heavy. You will not ask to be shown that this is true, you know it to be a fact. Years of experience and testing out have shown that the item of loss, the amount that goes up the

DAILY REPORT
OF
FOUNDRY TIME

HEAT No._____ Date_____ 191

HOURS			RATE		REMARKS
	Cupola	100			
	" Helpers	101			
	Air Furnace	105			
	" Helpers	106			
	Molding	110			
	" Helpers	111			
	Core Making	115			
	" Helpers	116			
	Chipping	120			
	Cleaning	121			
	Smithing	125			
	Crane Service	126			
	Clerks	127			
	Repairs and Renewals	128			
	General Labor	129			
	TOTAL HOURS				

HOURS		Per Ct.
	DIRECT TIME	
	INDIRECT TIME	

FIG. 7—DAILY FOUNDRY TIME SHEET

THE MORGAN ENGINEERING CO.
CUPOLA DAILY REPORT

CUPOLA NO._____ HEAT NO._____ DATE_____

	SI.	S.	P.	MN.	G. C.	C. C.	T. C.
ANALYSIS OF MIXTURE							
ANALYSIS OF HEAT							

PER CT.	MIXTURE	CAR NO	WEIGHT	SUPPLIES	LBS.
				CUPOLA COKE	
				LIMESTONE	
				CHARCOAL	
				FIRE CLAY	
				COKE BLACKING	
				SAND	
				BLAST PUT ON	
				DROP BOTTOM	
				CONDITION METAL	
				TRANSVERSE	
				DEFLECTION	
				TENSILE	
TOTAL CHARGE					
SURPLUS					

MATERIAL FOR	DRAWING NO.	PATTERN NO.	ORDER NO.	DESCRIPTION

FIG. 8—DAILY CUPOLA REPORT BLANK

stack and what is not recovered will, in a well-managed iron foundry, run uniformly. It has been demonstrated also, that where good conditions prevail, a loss slightly less than 3 per cent of the cupola charge can be obtained, while in shops where careless methods are the rule, there is no limit to the loss. By no means accept 3 per cent as a standard mark for *your* foundry. Find out what it is and use your own figure. If you use a rate just a shade higher than it really is, there will be a small accumulation of scrap not accounted for, which can be adjusted easily at any time.

Now, here is the proposition, and the solution of it. Assuming that 3 per cent would cover the loss, you have your good castings weighed to you, you have your bad castings weighed to you, and you have 3 per cent of your cupola charge representing your loss. The sum of these three amounts, deducted from your cupola charge, *must* leave the amount of your gates and surplus, the amount that ought to be recovered. With all sincerity I can say that this method has won out to the complete satisfaction of everyone I have known to try it, and it saves the necessity of weighing gates and surplus, except to verify the estimate for loss.

The melting supplies consist principally of fuel, flux and fire clay, and being reported daily on the cupola daily reports, it is a simple matter to make up the monthly report. Melting labor is taken from the Report of Foundry Time, Fig. 7. Assemble the three items—metals, melting supplies and melting labor—under Cost of Melted Iron, Table 1. By dividing each item by the number of pounds of good castings gives the cost of each item in one pound of good castings.

Table I.

March, 1912.

BASE FOR FIGURING FOUNDRY COST.

Net cost of castings		$0.019930
DEDUCT		
Molding	$0.003497	
Coremaking	0.001531	
Chipping	0.000836	0.005864
		$0.014066

Add actual molding, coremaking and chipping cost.

BASE, INCLUDING OVERHEAD IN DEDUCTION.

Net cost of castings		$0.019930
DEDUCT		
Molding	$0.003497	
Coremaking	0.001531	
Chipping	0.000836	
Overhead	0.003025	0.008889
		$0.011041

Per cent overhead is of molding, coremaking and chipping 52

Add actual molding, coremaking and chipping cost, plus 52 per cent, to get the cost on any one piece or job.

Table II.

FOUNDRY REPORT.

GENERAL SUPPLIES

				Total cost.
13.66	tons	stock coke	$ 2.95	$ 40.30
54.89	tons	stock coke	2.75	150.95
60.52	tons	Foltz sand	1.40	84.73
49.52	tons	sharp sand	0.80	39.62
24.10	tons	Alliance sand	1.05	25.30
12.32	tons	Tuscora sand	1.40	17.25
5.03	tons	Silica sand	1.10	5.53
4.45	tons	sea coal facing	5.10	22.70
2.79	tons	ventless facing	10.20	28.46
3.11	tons	core composition	24.00	74.64
1.71	tons	coke blacking	12.15	20.78
0.10	tons	flour	29.22	2.92
580		pounds Bull Run talc per 100 pounds	0.85	4.93
550		pounds plumbago	0.04	22.00
60		gallons molasses	0.14	8.40
5100		fire brick	24.71	126.02
				$674.53

FOUNDRY LABOR.

	Gross cost.	Cost per pound.
Molding	$3,214.44	$0.003497
Helpers	256.05	0.000278
Coremaking	1,407.14	0.001531
Chipping	730.83	0.000795
Cleaning	37.95	0.000041
Smithing	48.07	0.000053
Repairs and renewals	121.21	0.000132
Crane service	337.47	0.000367
General labor	1,429.49	0.001555
	$7,582.65	$0.008249

PER CENT OF TOTAL CHARGE.

Pounds.		Per cent.
919,213	good castings	80.82
16,578	bad castings	1.46
167,548	gates and surplus	14.72
34,021	loss	3.00
1,137,360	Total charge	100.00

PER CENT OF CASTINGS.

		Per cent.
919,213	good castings	98.23
16,578	bad castings	1.77
935,791		100.00

Table III.

FOUNDRY REPORT.

Cupola and Air Furnace Metals.

Pounds.	Gross tons.		Per ton.	Total cost.
143,960	64.27	Cherry valley pig	$16.75	$1,076.52
59,400	26.51	Cherry valley pig	18.90	501.04
21,200	9.56	Cherry valley pig	15.65	148.05
19,680	8.78	Dover pig	16.50	144.87
280,080	125.04	Dover pig	15.50	1,938.12
21,800	9.73	Seneca pig	17.40	169.30
2,400	1.07	Seneca pig	15.90	17.01
191,840	85.64	Bought scrap	14.25	1,220.37
115,300	51.47	Bought scrap	14.00	720.58
249,700	111.47	Our scrap	14.25	1,588.45
32,000	14.29	Steel scrap	12.00	171.48
1,137,360		Total charge.		$7,695.79
34,021		—3 per cent for loss.		
1,103,339		Amount melted iron.		
		Credit:—		
16,578		Bad castings.		
167,548		Gates and surplus.		
184,126		82.20 gross tons at $14.25		$1,256.85
		Net cost of metals		$6,438.94

Melting Supplies.

			Total cost.
57.20	tons	coal	$ 74.40
28.20	tons	coal	45.12
58.72	tons	cupola coke	211.39
10.00	tons	fire clay	19.00
8.86	tons	limestone	11.96
1,008	feet	rough boards	10.08
			$371.95

Cost of Melted Iron.

	Total cost.	Cost per pound.
Metals	$6,438.94	$0.007006
Melting supplies	371.95	0.000404
Melting labor	313.95	0.000342
	$7,124.84	$0.007752

Cost of Cupola and Air Furnace Iron.

	Total cost.	Cost per pound.
Melted iron	$7,124.84	$0.007752
General supplies	674.53	0.000733
Foundry labor	7,582.65	0.008249
Overhead	2,780.96	0.003025
	$18,162.98	$0.019759

919,213 pounds of good castings cost $0.019759 per pound.
Average weight of castings, 133 pounds.

The total of these extensions gives the cost of melted iron in good castings.

General supplies have already been noted on the Material Card, Fig. 1. Under this head are charged all material not included in metals and melting supplies. While I have thrown all these items together, they may be divided into molding supplies, core supplies and miscellaneous supplies, or each item can be carried out against one pound of good castings. But this would necessitate carrying out the extensions, instead of six places, to at least seven or eight places. Up to a certain point it pays to go into small details, but too much attention to unimportant details that bring no results, become a burden.

The distribution of foundry labor, which includes all labor except melting labor and salaries, is explained by the Daily Foundry Time Report, Fig. 7. The cost of each division of time, divided by the number pounds of good castings, gives the cost in one pound of good castings of all labor except melting labor. This affords an opportunity to check each item against the same item in former reports, and aids in determining the causes of a higher or lower labor cost.

Salaries should be distributed through the overhead. As the overhead is made up almost entirely in the accounting department, it could not be gone into in an explanation of a foundry report.

Having the cost of melted iron, general supplies, foundry labor and overhead, and having found the cost of one pound of good castings in each, their total will represent the average cost per pound of good castings.

Cost of Each Piece or Job

Having obtained the average cost of castings, we will proceed to show how to find the true cost of each piece or job. In studying the items of a foundry cost those which fluctuate most, and which in the largest measure contribute to a higher or lower cost, are molding, coremaking and chipping, cleaning being included in chipping. The other items remain more nearly constant as applying to the different pieces or jobs. Accepting this to be true, we will consider the base for figuring the foundry cost, Table III. Referring to the account of foundry labor, Table II, deduct the total cost of molding, coremaking and chipping from the average cost of castings. This establishes a base for arriving at the individual piece or job cost. If the record card, Fig. 2, has been properly filled out, you will have the *actual* molding, coremaking and chipping time. Find the cost of this time and divide by the number of pounds in the piece or job and add this to base. This substitutes the actual cost of these items for the average cost, which was deduced.

A closer cost estimate can be obtained by including the overhead in the amount deducted from the average cost per pound. Find what per cent the overhead cost is of the molding, coremaking and chipping cost—in this case it is 52 per cent—and increase the total molding, coremaking and chipping cost on the record card by this percentage. Divide this amount by the number of pounds in the piece or job, and add this to the base, including the overhead in the deduction.

Mottled Malleable Iron

By Richard Moldenke

Question:—We are experiencing considerable trouble with our malleable castings, and we believe that some of the defective sections contain phosphorous as high as 0.6 to 0.7 per cent. None of the pig iron in our yard analyzes over 0.2 per cent phosphorus, and in our mixture we use less than 5 per cent of outside scrap. The unannealed castings contain black spots and we are unable to account for this phenomenon. We have been advised that the black spots in our hard iron are formed by graphite and cannot be changed to amorphous carbon by annealing. We have been further informed that the high phosphorus would have a tendency to make the metal very liquid which would permit of a separation of the graphite.

Answer:—Analyses of your annealed samples follow:

(1) Silicon, 1.04 per cent; sulphur, 0.052 per cent; phosphorus, 0.538 per cent; manganese, 0.35 per cent; combined carbon, 0.08 per cent, and graphitic carbon, 2 per cent.

(2) Silicon, 0.95 per cent; sulphur, 0.056 per cent; phosphorus, 0.527 per cent; manganese, 0.35 per cent; combined carbon, 0.09 per cent, and graphitic carbon, 1.70 per cent.

The hard or unannealed iron analyzed as follows:

Silicon, 0.90 per cent; sulphur, 0.05 per cent; phosphorus, 0.527 per cent; manganese, 0.38 per cent; combined carbon, 1.68 per cent, and graphitic carbon, 0.90 per cent.

The defects in your malleable castings are due entirely to high phosphorus and I am surprised to learn that any blast furnace would ship such iron intended for malleable work. Perhaps, however, the pig iron was taken from the wrong stock pile in the yard and the iron for gray iron work was mixed with that intended for malleable castings. Unless the phosphorus is reduced to less than 0.2 per cent, bad results will continue. Furthermore, the silicon is entirely too high for light work. In the sample submitted the silicon should not be above 0.65 per cent and the high percentage of silicon in your castings, namely, 1.04 per cent, will cause mottling or graphite separation in the hard castings. As a result, the carbon change necessary for good work cannot occur. I do not entirely agree with the statement that high phosphorus will permit of the easy separation of the graphite, for in ordinary gray iron practice a 1 per cent silicon, high phosphorus, thin casting also will have a white fracture. I have made a number of tests with high phosphorus malleable for pot mixtures, which invariably turn out bad, as the metal could not withstand the effects of the high annealing temperature. The pots warped, cracked, and could only be used for a few heats, whereas a mixture of the same composition with low phosphorus gave good results.

Spongy Iron Difficulties

By N. W. Shed

Question:—We are experiencing considerable trouble with spongy iron. The sponginess occurs at the junction of the gate and in the cope. The analysis of our iron follows: Silicon, 2.11 per cent; manganese, 0.28 per cent; graphitic carbon, 2.79 per cent; combined carbon, 0.59 per cent; phosphorus, 0.864 per cent, and sulphur, 0.082 per cent.

Answer: — The sponginess in your castings is undoubtedly caused by oxidized iron. The coke may be of inferior quality and the blast too strong. This would cause a certain amount of oxide of iron in the metal and this, reacting on the carbon present, would produce gas, thus causing blow-holes. The graphite is too low and the manganese should be considerably higher. It might be well to use a lower blast pressure and to increase the coke slightly. A small amount of powdered ferromanganese added to the stream of metal as it flows into the ladle would deoxidize the iron and would have a tendency to produce a more solid casting. The iron has the appearance of being poured dull. A hot iron would produce better results. A good analysis for this class of work is as follows: Silicon, 2.30 per cent; sulphur, 0.07 per cent; phosphorus, 0.60 to 0.80 per cent; manganese, 0.60 per cent, and graphitic carbon, 3 per cent.

Should Risers on Molds be Covered?

A Discussion of That Recurrent Problem Which Has Never Been Satisfactorily Answered and Probably Never Will Be

By Pat Dwyer

YOU don't mind if I take a look in, do you? Oh! yes, I know the sign is up on the front gate, but I used to work at this business myself one time and it would take more than a sign on the gate to keep me out if I felt a desire to see the inside of a shop." Funny thing, that, about molders. They simply cannot pass a foundry without going in, look around quietly, if they are the quiet kind; talk to as many men as possible, if they are the garrulous kind, and if the gaffer hoists the big jib and bears down upon them, they will surely ask him for a job whether they need it or not, this honest and legitimate request being used merely as a peg to hang a conversation on.

Prowling Habit of Molders

Get two molders in the same shop comparing notes and they are both agreed that a foundry is not a fit place for a dog to live in, and if they had 17 sons they would not apprentice one of them to the trade. Yet as sure as they have a day off and nothing particular to do, the first place they dive for is one or more of the other foundries in the town. I suppose the reason is that a man always derives a certain amount of melancholy pleasure from seeing other men who are more miserable than himself. If you can offer any better reason, why, go ahead, don't mind me. I will probably pay no more attention to your opinion than you do to mine. You see, I am not exactly worrying over the reason; I am simply stating a fact when I refer to this prowling habit of the full-grown molder. The reason he does go visiting is—oh! well, if you really insist on giving your own opinion I don't care. Hearken to me, ye molders, I have done it myself times without number and so have you. And we will probably keep on doing it every chance we get. Molders like to visit each others' shops and they like to talk shop among themselves. For that matter they will talk it to anybody else charitable enough to listen. I have reason to believe that other craftsmen have the same failing, but I am not going to drag them into this.

"It is better to talk about the devil you know than the devil you don't know." I found that quotation floating around among other odds and ends in the spare room I have in my garret and used it for much the same reason that a molder puts a nice little ball of clay on top of each riser. It does not do any good, but gives the job a more finished look and adds one more trifle to the general air of mystery which clings around the making of molds. I have heard more argument on that ball of clay than would fill an ordinary parlor table family bible. But after coming back from a trip to Missouri I have tried the same castings with and without covering the risers and I have never known it to make any difference. A mold that is not in condition to receive the iron quietly will blow whether the risers are covered or not, and a mold that is in condition to take the metal in a calm and peaceful manner will not blow.

You do not need to take my word for it. If you are one of the riser covering class, I do not suppose you will. But the next time you see some open sand work being poured, just watch the way the iron acts. If the mold is as it ought to be the iron flows over it evenly and smoothly, but if the mold is too wet or too hard, there is more or less commotion and more or less slush and dirt floating around on top of the casting. If it were possible to cast everything in open sand or if some genius would invent an X-ray apparatus so that a molder could see through his cope while the mold was filling, it would explode about 50 per cent of our half-baked theories and reduce the scrap pile to the same extent.

Hard or Wet Mold

When a hard, or wet, mold is poured and the risers are left open, the blowing is apparent right from the start. If they were covered you would not notice this because all the steam and gas generated would simply be forced through the sand forming the cope and would attract no particular attention. Again, a mold will often boil off the bottom when the iron first covers it. This will stop as soon as the bottom is covered with a sufficient weight of iron and the metal will come up the risers quite peaceably. Now, if the risers were left open, this would be noticed and precautions taken to prevent it occurring next time, but if the risers were left covered until the mold was full and then the metal appeared nice and tame, it would be taken for granted that no disturbance had taken place and the next casting would be made in the same way and the chances are that both castings would find their way to the machine shop and not be scrapped until the machinist had gone to the expense of setting them up and done considerable work on them.

A Boiling Mold

It goes without saying that a boiling mold will, in all probability, produce a defective casting. There are times when the defect will be distributed and land in places where even the machinist cannot find it. But as a general rule he can be depended on to locate these jokers. When the machine shop and foundry foremen are working in harmony, these instances are causes of mutual regret, but when, as we generally find them, at swords' points each of these cases affords the former an excuse for unholy exultation and the latter has to draw on some of the most able-bodied words in his vocabulary to express his feelings.

Every molder knows that some sands will stand more water and ramming than others, also that some molds must be rammed harder than others to withstand straining, which is caused either by a high head or heavy section, or both. It requires a high degree of skill and experience to determine just what the limit is. If the risers were all left open and a man paid attention to them while pouring, he could keep tab on his job, while if they were closed he would just go poking along in the dark. Some molds will blow so wickedly that even a blind man will know what is going on. I am not referring to these desperate characters, nor do I include these castings which come out with buckles and scabs on them. The cause of these is obvious. The kind I have in mind are the sly-sleek looking ones that do not reveal their rottenness until they have been

cleaned, chipped, weighed, shipped to the machine shop and partly finished. The castings that are scrapped in the foundry are expensive enough but these latter villains are heart-breakers.

A Foundry Axiom

Furthermore, it may be regarded as an axiom (not of Euclid, but just an every-day axiom) that the hotter and more fluid iron is poured the cleaner will be the resulting casting. If iron enters and fills a mold in a hot, fluid condition, the casting will be solid, barring shrinkage, of course, which is an after consideration. If the metal boils in a mold the temperature is lowered, and the steam that is causing the trouble gets caught by the legs and is held in the metal with the result that when a cut or two is taken off the face, the casting looks as if it had just recovered from an attack of smallpox.

Try This for a Peek-a-Boo Effect

Try it yourself, dear lad. Remember that I have nothing to sell, nor have I any designs on the vast wealth you are daily extracting from the foundry business. I have met so many people who think that because iron rises quietly in the risers, therefore the casting should be solid, that I should like to see you try the following experiment. Make a small open sand plate, 6 x 6 x 1 inch. Either make it a little harder or a little wetter than a mold should be. Pour it slowly and watch it. At first the iron will boil violently, but before the mold is full, it will stop and remain quiet. When cold, break it and you will find that, while the skin on top is quite solid, yet under that skin is a regular peek-a-boo effect. Quite interesting from an artistic point of view, or as an evidence of the workings of some of the natural laws, but rendering the casting worthless if any machine work is necessary.

Cast Prejudice Aside

Again, the theory that a covered riser helps to keep the cope from *drawing down* is, in the words of one of these fellows who invent cute sayings, *all my eye*. Just sit down on the edge of a flask and consider the matter calmly. Put all prejudice and malice to one side and consider the proposition as if it were put up to you for the first time by some person to whom you wished to give a sensible, truthful answer. In other words can you cover your heart so-help-you and say that you really believe a covered riser helps to hold the face of the cope in place? You know, and I know, that a great many things are done in the foundry just because the other fellow does them. We never stop to figure it out for ourselves whether they are necessary or not. I will just mention one extreme case to illustrate this point. A certain molder had a habit of sprinkling flour on the joint of his mold every day before closing in order to see how the cope *touched*. After going all around the joint he would scatter whatever flour was left in his hand over the face of the mold. This man was a No. 1 molder and naturally his moves were imitated. Inside of a month there was not a man in the shop who would think of closing a mold without first throwing a handful of flour over it. Oh! yes, I know it did not injure the mold any, but castings came just as good after the practice had been stopped and besides a barrel of flour does not grow in a foundry spontaneously. When asked about it some of the men had a theory that the flour and blacking became united in some mysterious manner and prevented cuts, buckles and scabs. Much on the same principle that the average citizen swallows a dose of Dr. Quackem's extract of dog juice and believes that it will cure coughs, colds, hoarseness, sore-throat, bronchitis, asthma and whooping cough, and ladies and gentlemen, all diseases of the respiratory organs, the chest, throat and lungs, 50 cents for the large bottle, 25 cents for the small one.

Tearing Up the Mold by the Roots

The theory of the covered riser is that it prevents the air rushing like a tornado ahead of the iron, tearing everything in its path up by the roots, also by keeping the air confined it is compressed to a certain extent and by pressing against the face of the cope it prevents the same from dropping. As I have already pointed out, if the mold is properly made, there is no commotion or boiling when the iron enters. The risers are either as large or larger than the runners and, therefore, the air has as good a chance to get out as the iron has to get in. The body of sand of which the mold is composed, is so porous that the air has an ample opportunity of escaping if there were no riser at all. You can see instances of this every day. As for the air being compressed enough to hold up a piece of sand that felt like dropping, well I would not like to pin my hope of salvation on such a contingency. In order to compress air, either *hot* or the ordinary variety, an air-tight compartment is essential, and I do not think a mold composed of sand will be classed under that heading.

Galvanizing Small Sheet Steel Products

By F. Webster

Small objects, such as caps for roofing nails, washers, etc., made of sheet steel can be galvanized advantageously in bulk by the electroplating process. Use a wooden barrel mounted on a brass shaft and immersed half its depth in the plating solution. Hang about a half dozen sheet iron cathodes onto the brass shaft in the barrel, and fill-in around them the small articles to be plated with zinc. From a brass rod located along the side of the vat parallel to the shaft of the barrel suspend zinc anodes. These anodes should cover the length of the barrel and about one-quarter of its circumference, being bent so as to conform to the outer surface of the barrel, and held within two inches of it. Operate the barrel about two revolutions per hour. The work should be cleaned in a 16 to 1 sulphuric-acid dip. This work can be easily done in a barrel similar to the one used for plating. After the acid dip, wash in hot lime water and then in hot clean water before putting into the plating bath. The plating bath is made up of 1½ pounds of zinc sulphate, 1½ pounds of aluminum sulphate and 5¼ ounces of dextrose per gallon of water.

Foreign Molding Machine Installations

Ph. Bonvillain & E. Ronceray, Paris, France, manufacturers of molding machines, have recently made the following installations: Etablissenments Arbel, Couzon, France, one universal rotative machine; Compagnie des Compteurs et Materiels, Lille, France, two universal molding machines, including the necessary hydraulic equipment; Giesserei Embru, Ruti-Zurich. Switzerland, one universal molding machine, vertical pump and accumulator; Geb. Horber, Netstal, Switzerland, one universal molding machine, one rotative molding machine, vertical pump and an accumulator; Giuglardi Co., Novi-Ligure, Italy, two universal molding machines, one rotative machine and vertical pump, an accumulator and a varied line of foundry equipment; William Cross & Sons. Bromwich, Eng., one hydraulic molding machine; Samuel Osborn & Co., Sheffield, Eng., one type A6 molding machine. Numerous other installations also have been made recently in foundries in Germany and Austria-Hungary.

Emergency Jobs With Inexpensive Rigging

How Large Castings Were Molded and Cast in a Western Foundry at a Minimum of Expense

CASTING departments of plants manufacturing heavy machinery of special design or engaged in jobbing work are frequently required to make castings of large size or irregular shape without the aid of the special equipment which enables the purely manufacturing shop to turn out its product so cheaply. Problems of this kind tax to the utmost the ingenuity of the molder. Competitive conditions demand that the work must be done very economically. Usually, only one casting of a kind is required so it is not possible to invest much money in pattern work and the time element is also frequently an important factor. The castings are generally required in a hurry and the foundryman must make the best of the apparatus which he has at hand without delay. Conditions of this sort frequently arise in the foundry of the Bucyrus Co., South Milwaukee, Wis., and this article will describe how two large castings were made quickly and economically without the expenditure of money on special devices which would afterward be practically useless.

In the construction of a large suction dredge some special cast iron pipe elbows, 30 inches in diameter, were required. The drag half of the mold for one of these elbows, together with the core and simple rigging used on the job, are shown in Fig. 1. This elbow has an angle of approximately 22 degrees. If a large number of duplicate elbows were required a solid pattern, together with a core box would probably be made. If a lesser number were wanted, a skeleton ribbed pattern would be used, sand being filled in between the ribs to conform to the outline of the casting. This method would also require a core box. But in the case under consideration no duplicate elbows were required and it was advisable to avoid as much expensive pattern labor as possible. A method was, therefore, devised which eliminated the use of a core box and required only the simplest kind of pattern work.

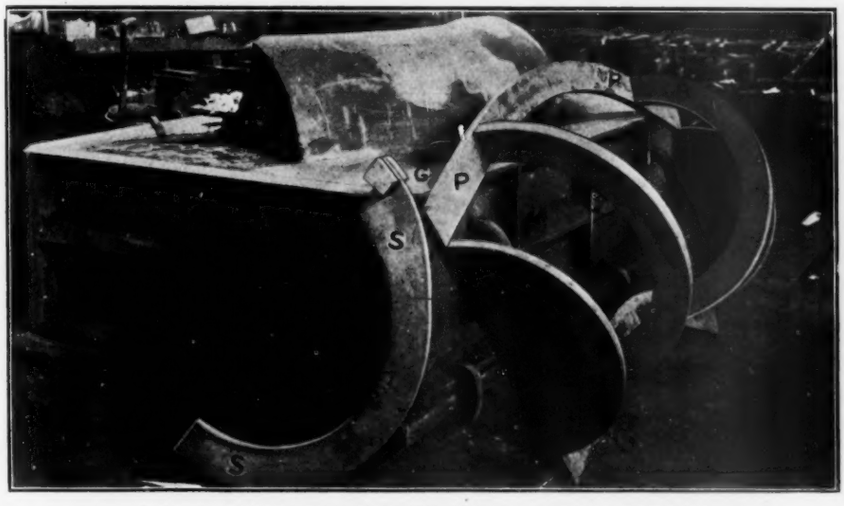


FIG. 1—MOLD AND RIGGING FOR A 30-INCH ELBOW

A skeleton pattern, *P*, Fig. 1, which also served the purpose of a core box, was made. This consisted of only six pieces of wood, the two semi-circular rings, *R*, serving as patterns for the flanges of the elbow. A sweep, *S*, was also made, its diameter being equal to the inside diameter of the casting. Blocks as shown in Fig. 1 were nailed on one end of the sweep in order to guide it properly around the curved edges of the pattern frame.

In making the mold the skeleton, or frame, *P*, was placed on the floor and was used for sweeping-up half of the

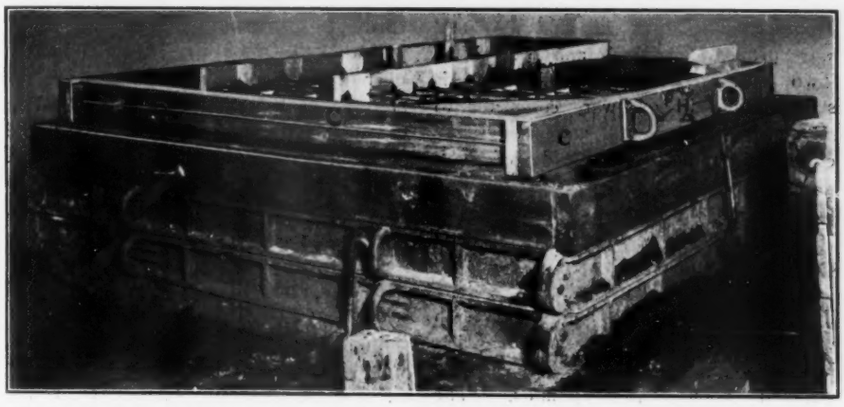


FIG. 2—FLASK CONTAINING THE MOLD FOR A FRONT HEAD CASTING FOR A SUCTION DREDGE

core, which was made in loam. This half core was properly rodded and was provided with rings so it could be easily handled by the traveling crane.

After the core was baked it was brought back to the molding floor and covered with a coating of clay, 1½ inches thick, this being the thickness of the metal in the casting. The clay was very stiff and was made-up in wedge-shaped strips which were bent over the core.

The half core with its covering of clay was now used as a pattern. It was placed on a bottom-board, surrounded by the drag and rammed. The drag was then rolled over, the bottom-board removed and a smooth parting made. The top or cope half of the core was next swept-up, using the same skeleton and sweep which had been utilized in making the first half. This half of the core was built at its proper position in the mold and when finished appeared as shown in Fig. 1. A layer of clay was next put on the cope half of the core, similar to that surrounding the lower half and the cope was fitted to the drag, filled with sand, rammed and lifted off. The clay on the top half of the core was next removed and the entire core lifted out of the sand and put back in the oven to bake. The top half, up to this point, had not been dried.

The wooden rings which form the flanges of the elbow were removed

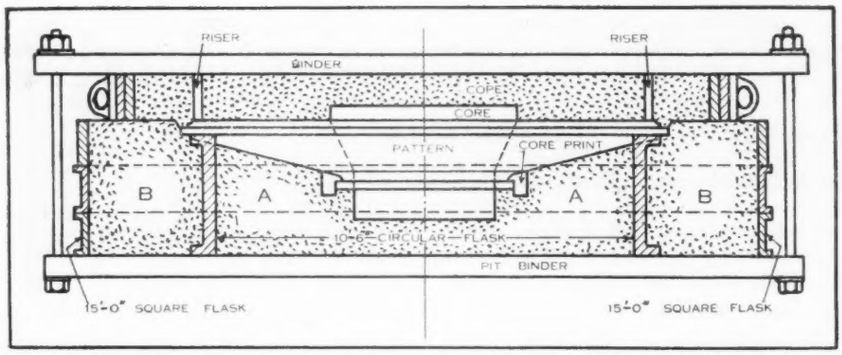


FIG. 3—CROSS-SECTION OF MOLD FOR A 9,000-POUND SUCTION HEAD

from the cope and drag and the mold was properly finished and skin-dried. Two pouring gates, one of which is shown at *G*, Fig. 1, were connected to one flange of the mold and risers were connected with the top side of both flanges. By this method of gating any dirt in the metal would naturally be forced out through the risers, insuring a clean casting.

A heavy-ribbed and bolted cast iron flask, 8 feet in length and 4½ feet in width, was used, the cope and drag being each 2 feet in depth. The casting weighed about 2,000 pounds. The method of molding adopted, while not ideal, saved a great deal of expensive pattern work and a large core box, and since only one casting was required, was probably the most economical way to handle the problem.

Another Molding Job

Fig. 4 is a sketch of a casting weighing about 9,000 pounds, which was molded in the flask shown in Fig. 2. This is what is known as the front head of a large suction dredge and is 10 feet, 10 inches in diameter, 18 inches in height with a conical bore and ribs, as shown in the illustration. The metal in the casting is about 2 inches thick. When this job was received in the foundry, the foreman found that his largest circular flask was only 10 feet, 6 inches in diameter. The next largest flask on hand, available for the job, was 15 feet square. The latter was a bolted cast iron flask and was not stiff enough to be rolled over; also, the head room under the traveling crane was not sufficient to roll over a flask of this size. It was necessary to get out the casting in the shortest possible time and the foundry was, therefore, obliged to go ahead without waiting for any additional rigging.

After studying the problem for a time, the foreman decided to use both flasks, rolling the pattern over in the smaller one and finishing the mold with the larger. The pattern was accordingly clamped to a bottom board and the 10½-foot circular flask placed over it. The sand surrounding the pattern, *A*, Fig. 3, was then rammed in carefully and the flask rolled-over and placed on binders in a shallow pit. It then occupied the position shown in Fig. 3. The large 15-foot square flask was next placed outside the circular flask and the space between the two flasks, *B*, Fig. 3, was filled with sand dropped in with a grab bucket. The bottom board, covering the pattern, was then removed and a wooden cope, *C*, Fig. 2, slightly smaller than the drag, was put in position and rammed. The photograph from which Fig. 2 was reproduced was made while the cope was being rammed. The drag, as shown in the illustration, consists of two cast iron sections, two feet in height, with a wooden section added on top to give it the necessary depth. When the cope was completed it was lifted off by the traveling crane, using the handles shown at *H*, Fig. 2. It was finished in the usual manner and dried with charcoal.

Economies Effected

As soon as the cope was lifted the pattern was removed, the cores were set and the mold was gated and closed. The drag was also skin-dried. After closing, the flask was fastened together by binders and clamps, as indicated in Fig. 3. Two pouring gates in opposite corners of the flask were used, with risers around the rim of the casting. About 108 hours of molding labor were required for the job, a molder and a helper being employed on it for a week. With more expensive rigging and more suitable flasks the mold could undoubtedly have been made in much less time. The job as described, however, shows how the foundryman is often required to meet conditions as they arise and he displays his skill by the ingenuity with which he overcomes the difficulties that are presented.

Scully-Jones & Co., 316 Railway Exchange building, Chicago, have been appointed exclusive agents in the states of Illinois, Indiana, Iowa and Wisconsin for the sale of high speed steel manufactured by Vickers Sons & Maxim, Ltd., Sheffield, Eng.

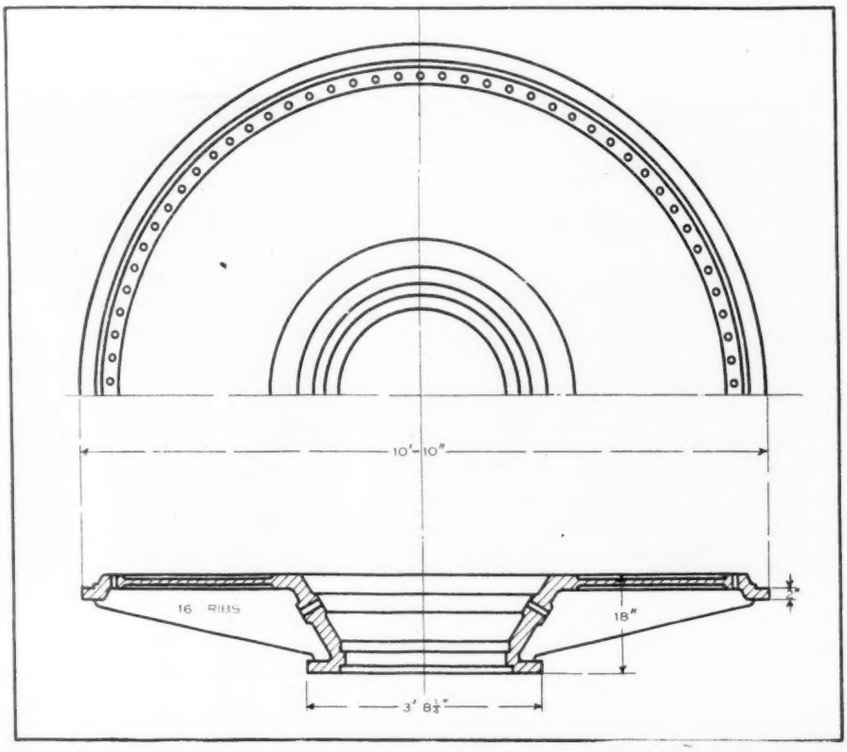


FIG. 4—SKETCH OF THE GRAY IRON FRONT HEAD CASTING, WEIGHING 9,000 POUNDS

THE AMERICAN PLATER

The Operation of Duplex Copper Baths

By Seymour W Rowsbar

FOR many classes of work and various finishes, an acid copper solution is indispensable. While the solution is comparatively easy to operate it requires care and attention in order to maintain perfect conditions continually. The average plater is aware that an acid copper solution cannot be employed to deposit copper directly on iron or steel, as these metals are at once attacked by the sulphuric acid and the local action causes the deposit to be non-adherent and it is thrown off as rapidly as formed. Iron, steel and zinc require a coating of copper deposited in a cyanide bath or a covering of nickel, before being placed in the acid copper solution. The sulphate copper solution is frequently termed an electrotyping solution. The solution used to obtain the results desired by electroplaters is somewhat different from that used by electrotypers, the density of the bath and amount of free acid varying according to the nature of the work. When plating work with projections, it is often advisable to use only 1 per cent of acid, while flat work or electrotyping will allow the use of at least 5 per cent for good results, the acid affording better conducting qualities as a rapid deposit. The density of the solution may range from 16 degrees Baume to 22 degrees. As the water evaporates, the density increases, consequently more water should be added. A large anode surface is essential. A small anode surface causes the solution to become acid. When too acid, the solution may be neutralized by the addition of carbonate of copper; effervescence ceases when the neutral point has been reached and the proper proportion of acid then may be added. Some of the solution may have to be removed and water added to bring the solution to the proper density.

Preparing the Acid Copper Bath

Acid copper baths seldom need the addition of sulphuric acid after once being prepared, free acid being constantly formed in the solution while deposition is going on. The usual method of preparing an acid copper bath is to dissolve sulphate of copper in water until a density of from 12 to 18 degrees Baume is obtained: then sulphuric acid is added until a density of from 13 to 20 degrees is reached or an increase of 1 or 2 degrees above that of the sulphate solution. For those who prefer to use exact quantities when preparing the bath, the following is recommended: Sulphate of copper, 2 pounds; sulphuric acid, C. P., 2 ounces, and water, 1 gallon. To this may be added 2 ounces of powdered alum previously dissolved in water. The addition of alum has been found to be very beneficial to an acid solution of copper. The alum takes up a portion of the free acid and forms sulphate of aluminum, which acts somewhat as a brightener and renders the deposit smooth and velvety when the proper voltage is employed. The solution must be kept free from dust for fine work.

Agitated Solutions

When agitated, the necessity of cleanliness will at once be more apparent. The solution does not have the cleansing properties possessed by a cyanide solution, therefore, special care should be observed in handling the work. An agitated solution will permit the use of a higher current density and produce a deposit of splendid quality very rapidly. Electrotypers employ a mechanical arrangement by which the cathode rod is kept moving or the solution is agitated by means of air or a stirring apparatus. Baths which are constantly agitated do not show the tendency to produce a knotty deposit such as is obtained in the still solution. A copper shell deposited on a wax mold in an acid bath may be made so thin and yet so perfect that a 2 x 2-inch mold, weighing only ⅝ ounce will stand an internal air pressure of 60 pounds. The writer has endeavored to reduce the weight to ½ ounce, but failed to obtain a perfect shell. If a copper sulphate solution containing no acid is used for electroplating, the deposit will be non-adherent, brittle and of a dark color. This is due to the deposition of a suboxide of copper together with the copper. The presence of free acid prevents this difficulty.

It is claimed by some authorities that the addition of transparent, white gelatine will render the deposit bright in a manner similar to arsenic in a brass bath. Others recommend the same remedy for a hard, streaky deposit, 2 or 3 ounces of transparent white gelatine being dissolved in a pint of hot water, 1 ounce of nitric acid being freely added. When using an acid copper solution exclusively for work with the ormulu finish, it is excellent practice to use iron chips or cuttings from lathes to neutralize the free acid which may accumulate in the bath instead of carbonate of copper. Sulphate of copper should be added regularly if the bath is in constant use. The crystals will dissolve readily if suspended in the solution in bags. Chemically pure dextrin is extensively used to produce a smooth, tough deposit and is especially adapted for baths employed in obtaining extra heavy deposits. The pure dextrin should be used, as the commercial article contains a percentage of gluten which is of no advantage to a copper solution. One ounce of the dextrin is used to each gallon.

Operating the Solution

The electrical connections and all tank rods should be kept cleaned to avoid possible trouble from the increased resistance and consequent decreased current supply. Thirty amperes per square foot will produce a deposit of copper about 0.0015 inch thick in one hour. From 8 to 15 amperes per square foot is a suitable current for the general run of work. The current should be increased as the work progresses, particularly if allowed to run continually for several days, as is sometimes the case. When experiencing trouble with a duplex bath try the effects of various strengths of current upon the

solution and you will readily see the necessity for using a low voltage. From ½ to 1 volt gives the best results in ordinary cases. As acid copper solutions do not throw the metal well, articles with cavities or hollows should be suspended in close proximity to a projecting anode or the anode suspended so as to allow the metal an easy passage to the bottom of the cavity. In this manner a uniform deposit may be given irregularly shaped pieces. The formation of streaks on acid copper deposits is often the cause of worry to the careful plater, but may be averted easily by exercising care in adjusting the current. Splendid deposits may be produced in solutions of 22 degrees Baume if the plater understands how to alter the current to suit the composition of the bath. There is no fixed density at which either solution or current must be used, but the plater must take into consideration the distance from the anode to cathode, etc., and carefully note the quality and condition of the deposit from time to time. The current should never be used strong enough to liberate hydrogen gas, the deposit under such condition being sandy, nonadherent and of a dark color. The tank rods and connections should be sufficiently large to allow the passage of a suitable volume of current if best results are desired. The proper current strength is of great importance and a voltmeter is indispensable if good work is expected, for without it everything is mere guesswork and success is a matter of mere chance. The articles in the bath should be turned occasionally or their line of suspension altered in order to obtain a uniform deposit. If the acid solution is used to deposit copper upon tubular articles of iron or steel, or any pieces of these metals having depressions of such a nature as to render it impossible to cover the indented surface with a coat of copper or nickel, prior to being placed in the acid bath, the surface must be protected by either wooden plugs, wax or asphalt paint, as the acid will ruin the article if left exposed. The management of the duplex copper bath will prove the ingenuity of the plater and afford him every opportunity to exercise his skill in producing a perfect electro-deposit.

TROUBLES OF THE ELECTRO-PLATER

Discussed by Practical Men

Silver Solution for a Heavy Deposit

Please publish a formula for a silver solution capable of producing a heavy silver deposit on military uniform equipments. I have several sets to refinish for a military branch of a fraternal society and the contract specifies extra heavy silver plate.

Precipitate 28 ounces of nitrate of silver as chloride by first dissolving in water, then adding common salt or hydrochloric acid as long as any precipitate is noticed. Then wash the precipitate several times until free from acid and use the following: Chloride of silver, 17½ ounces; cyanide of potassium C. P., 1¾ pounds; water, 5 gallons. Work the solution at 65 degrees Fahr. and maintain a good surface of pure silver anodes in the vat.

Greenish Brown Color On Brass

I would like to know how to obtain a greenish brown color on brass.

Dissolve the following in an enameled iron vessel: Copper nitrate (weight), 1 ounce; water (measure), 1 ounce; use warm, 120 to 150 degrees Fahr. The articles are cleaned and rinsed in the usual way, then brushed repeatedly with the mixture until the desired shade is obtained. Then put on a heater or hot plate to dry. If necessary, repeat the operation. When the final color is obtained dry as before and pass through fine boxwood sawdust. Finally brush the surface with French chalk with a soft bristle brush and then lacquer.

Brass Plating for Automobile Parts

The sales department of the company with which I am connected is complaining of the poor quality of brass plating on the automobiles. Will you kindly advise me of the method employed by concerns in this line of work? The parts mentioned receive severe wear and friction in actual use and in cleaning.

The automobile makers who are applying the best brass plate are giving the work an extra long run in the plating bath. One concern which is noted for the excellent wearing qualities of brass plate runs its work continually for eight hours with frequent scratch-brushing. The steel parts are first heavily copper-plated in a hot cyanide bath, lever handles and coat rails being given an hour or so in an acid bath. The work is coppered one day and is brass-plated the following day. The brass bath should produce a matte surface requiring a scratch brush in from 1 to 1½ hours time. If you have been depositing the brass directly on the steel you will find a wonderful improvement in the preliminary copper coat. Scratch-brush the copper deposit before placing in the brass bath. Be sure the brass bath is conducting properly and is free from arsenic. Do not expect the best results as to durability if arsenic is used in the brass solution. It retards the action of the bath and as the work is finally buffed it is of no advantage to deposit a bright plate. A clean, uniform, scratch-brushed deposit of good color will color on the buff quite easily and will wear much better.

Plating Steel Ball Cups

We plate case-hardened steel ball cups, the faces of which are polished and are thinner at the edges of the axle holes than at the outer circumferences. These cups frequently show very bad cracks in the face side after plating and are useless. Can you tell us why the cup should become cracked in plating?

It is quite possible that the cups are cracked in grinding, by being ground too rapidly, the heat generated suddenly doing the damage. Even when water is run on the work this is liable to occur, unless care is observed, sudden expansion and contraction being responsible. The fault is not in the use of water, but in forcing the grinding be-

yond the proper cutting limit of the wheel. The cracks, thus caused, may be very fine, but are enlarged during preparation for plating. Assure yourself that the cups are perfect when received in the plating room by examining with a glass, after careful cleaning in a warm solution. If found to be sound, the cracking is probably caused by dipping from a hot to a cooler bath, or *vice versa*. If you are using a sulphuric acid bath, the trouble may be caused by plunging the cups in it. If such is the case the cleaning operations should be performed in cooler dips to avoid the extremes of heat and cold in dipping. Surround the dips with running water by placing crocks on bricks built-up in the cold water tank.

Wire Resistance

In conducting experiments I frequently wish to know the resistance of a certain size wire and I am often so situated that a wire table is out of the question. Can you inform me of a method by which I may determine the approximate resistance of a wire without using a wire table?

The resistance of a wire varies inversely as its cross-sectional area. A wire three sizes smaller than a given wire will have a resistance twice as great and a wire three sizes larger will have a resistance one-half as great as that of the given wire. Having reference to the B. & S. wire gage, if we take any gage number as a basis of comparison, then by adding three to the gage number we obtain the number of a wire having very nearly one-half the cross-sectional area. Take the following as an illustration: One No. 7 wire will have the same cross-sectional area as two No. 10, as four No. 13, as eight No. 16, etc. By subtracting three from any gage number we obtain the number of wire having very nearly twice the cross-sectional area, as follows: No. 1 has twice the area of a No. 4; No. 10 has twice the area of a No. 13. The ratio between the area of each wire and the next smaller is equal to the cube root of two or 1.26, and in order to obtain the size of a wire of twice the area of a given wire we must multiply the area of the given wire by this ratio three times; therefore, the cube of the ratio must be equal to two. The ratio between the resistance of any wire in the B. & S. gage and that of the next higher number is that of 1 to 1.26. The ratio between the resistance of any wire in the B. & S. gage and that of the next lower number is that of 1.26 to 1. It is a convenient fact to remember that the diameter of a No. 10 wire in the B. & S. gage is very close to 1-10 of an inch (0.10189) and that its resistance per thousand feet is practically 1 ohm (1.0199). For very accurate calculations we would advise the use of a table giving various properties of different sizes.

Royal Silver Dip

Will you inform me through the columns of your paper of the composition of the Royal silver dip used for cheaply refinishing kitchen cutlery? I believe it is used in a molten condition by aid of heat.

The Royal silver dip consists of lead, 8 parts; bismuth, 8 parts, and tin, 3 parts. Clean the articles and immerse in a chloride of zinc flux made by dissolving scrap zinc in hydrochloric acid until no more will dissolve. The metal is a fusible alloy which melts at about 210 degrees Fahr., and may be quite readily melted over a common gasoline flame. The finished article has an appearance somewhat resembling silver, but tarnishes easily in ordinary use or when wet by any alkaline solution, such as soapy dish water. The claims usually made for this finish are greatly exaggerated. It is of little consequence as a commercial finish.

Soft Solder

I understand that a solder can be made which has greater strength than the ordinary soft solder and melts at a lower temperature, which renders it especially adapted for use on antimonial lead, pewter and other soft metals. I would like to know more about it.

The mixture you refer to is the one containing cadmium. The addition of cadmium lowers the melting point of soft solder composed of tin and lead and also increases its strength. The proportions for a good working mixture are lead, 1 pound; tin, 2 pounds, and cadmium, 1 pound. Mix the metals together and use a small quantity of ammonium chloride on the surface for a flux. Stir the solder well to thoroughly mix before pouring. The melting point of this solder is about 30 degrees lower than other soft solders composed of tin and lead, 2 to 1.

Finishing Aluminum Castings By Tumbling

We are trying to procure a smooth finish on aluminum parts. The castings are about 3 inches wide, 5 inches long and 5/8 inch thick, with a 2 x 4-inch hole in the center. We have tried steel balls in a horizontal barrel with soft soap, but the surface becomes pebbled from tumbling with the balls. Can you inform us whether it is possible to obtain a finish on aluminum castings by tumbling and how it is done?

You should be able to finish the castings by tumbling. To procure a brilliant surface you may have to buff the parts after tumbling. It depends largely on their size and shape. First you require a good barrel, one built for ball burnishing. Results may be obtained in a water-tight horizontal barrel, but not as easily as by using a special barrel. When tumbling aluminum with steel balls it is advisable to run the barrel considerably slower than for steel or brass goods. The charges also should be smaller and the use of the smaller sized balls also is necessary. Some firms using the burnishing barrel make a special holder for use in the barrel when operating on large and light pieces to prevent the parts striking or rubbing each other and obtain good results in this way. Still another method is to use a burnishing barrel made for the purpose which is kept dry. Clippings of chamois skins and a sufficient quantity of steel balls are used to keep the work separated and to give proper pressure for the buffing effect required. In this way very high finish may be obtained on aluminum or plated steel and brass parts. If the work is discolored use burnishing soap chips instead of soft soap. If the suds are of a sticky, dirty nature, be more careful in cleaning the work before placing it in the barrel and also add a piece of cyanide of potassium about the size of a walnut.

Copper and Brass Finishes

We would like to receive formulas for old copper, antique copper, dead brass and old brass finishes.

For old copper, take a quantity of red sulphide of antimony and mix with it liquid ammonia to make a thin paste that will spread uniformly. Apply to articles with a brush and dry by heating in a lacquer oven or permit to dry in the air. When the paste is dry, brush it off with a tampico brush, then coat with flat lacquer or wax.

For antique copper, slightly oxidize the copper with liver of sulphur solution which is used cold, then immerse the article in the following solution: Water, 1 gallon; copper nitrate, 5 ounces; ammonium chloride, 5 ounces, and calcium chloride, 5 ounces. Dry without rinsing and lacquer.

For dead brass dissolve metallic zinc in nitric acid until the acid will dissolve no more zinc. When cold, add to each gallon of this solution one gallon of oil of vitriol. This will result in the sep-

aration of the sulphate of zinc and the solution will become a milky white. The white precipitate at the bottom should be constantly stirred during use. Dip the brass in this solution and permit it to remain therein until the action ceases. The article is then rinsed and dried, and if desired, the high lights can be relieved, after which a coating of lacquer is applied.

To obtain an old brass color, a good yellow brass casting or rolled brass base is required. Acid-dip the article to produce a clean surface and polish slightly on a felt wheel with fine emery. Clean the object and again dip slightly, after which it should be immersed in a cold solution of 1½ ounces of liver of sulphur and ¼ ounce of liquid ammonia for each gallon of water used. This produces a gold tint. Next wash the object well and immerse it for about two seconds in a cold solution of ½ pound of sulphate of copper and ¼ pound of sal-ammoniac for each gallon of water in the solution. Remove the object and then wash again in cold water. After being dried, scratch-brush lightly with a fine, crimped brass wire brush. If desired, relieve high lights with dry pumice and coat with transparent lacquer.

Tinning Gray Iron Castings

We would like to know how to tin gray iron castings?

Owing to the uncombined carbon or graphite in gray iron castings, the preparation of the object differs slightly from that followed in preparing wrought iron for a coating of tin. The castings are pickled in a 10 per cent solution of hydrofluoric acid for from 5 to 30 minutes, depending entirely on the condition of the surface. The acid solution is contained in a lead-lined or wooden tank. After pickling, the castings are tumbled, if their size and shape will permit of this operation, in order to obtain a bright surface. The solution in which the castings are tumbled should contain 10 per cent of sal-soda, which has a tendency to neutralize the acid left in the pores of the castings. Large castings may be sand-blasted after pickling, or they may be tumbled and pickled in one operation by the use of a gas barrel, which is a horizontal tumbling mill provided with two safety valves at either end. The solution used for tumbling and pickling in this way consists of two gallons of strong muriatic acid for 100 gallons of water, to which 2 pounds of sal-ammoniac is added. Hard iron stars are tumbled with the castings to aid in removing the graphite which forms on the surface of the castings as the operation proceeds. After tumbling, the castings should be transferred quickly to a tank of cold water and if the castings are small, they can be placed in a wire basket of wide mesh. Large castings must be handled singly by hooks or tongs. The castings are then immersed in a strong caustic soda or potash solution to remove grease and when they are cleaned, they are rinsed in cold, running water. The castings are next dipped for a few seconds in a solution consisting of 5 gallons of muriatic acid for each 100 gallons of water.

The castings are now ready for the flux, which consists of a saturated solution of muriate of zinc to each gallon of which 5 pounds of sal-ammoniac should be added. The muriate of zinc is made by dissolving metallic zinc in muriatic acid until a saturated solution is obtained. To obtain the best results, pure Straits or Banca tin should be used. The addition of lead causes the surface of the finished work to tarnish readily. Before beginning the tinning operation the molten tin should be covered with a quantity of the zinc flux to a depth if about ¼ inch. To this flux a small amount of sal-ammoniac should be added. The castings are dipped into the flux and are then immersed in the molten tin. They should be kept submerged in the tin bath until heated and completely coated. They are then removed and the excess tin is shaken off by a quick motion. When baskets are used for small work the article should be shaken while in the bath so that all portions will be exposed to the tin. Care also should be exercised when immersing the castings in the tin to avoid excessive boiling or splashing. As the first coating is usually rough, the castings again should be subjected to this treatment to obtain a smooth, bright surface. The temperature of the tin in the second bath should be slightly lower than that of the first bath, and the surface of the metal in the second bath should be slightly lower than that of the first bath. The surface of the metal in the second bath should be covered with pure tallow to a depth of ½ to 2 inches and some operators use a mixture consisting of 1 pound of palm oil and 5 pounds pure tallow. The oil serves as a flux, prevents oxidation, insures a more uniform surface and makes the tin run freely. When the casting has had time to heat and the tin has completely covered the surface, it is removed and shaken quickly to remove the excess tin. The casting may be allowed to cool either in the air or may be directly immersed in a cold kerosene bath. After removal from this bath, the castings are cleaned in boiling water. On high grade work three or four tinning baths are sometimes used to produce an extra heavy coating and each bath necessarily is maintained at a slightly lower temperature than the one preceding.

How to Clean Enamel

We have an enameling dip tank containing 150 gallons of black baking enamel. We find that when obtaining fresh supplies of enamel from the storeroom the men have carelessly used a funnel employed for oil and in this manner have introduced a considerable quantity of oil into the enamel. The enamel is quite useless in its present condition, yet the real value of the material is such that we do not wish to lose it if it is possible to save it. We shall greatly appreciate any information you may be able to give us as to the possibility of cleaning the enamel.

To cleanse the enamel and thoroughly remove the grease or oil, procure about 5 gallons of benzole. Pour the benzole into the enamel and stir well. Then protect the enamel from further contamination by placing a cover over the vat, allowing the corners of the cover to rest on four blocks in order to permit a circulation of air underneath. Leave the dip undisturbed for three or four days. Then remove the extraneous matter from the surface and the dip is ready for use. It would be advisable to keep your own stock in barrel lots in the enameling department and use utensils kept for the purpose only. The benzole may be somewhat expensive, yet it is but a trifle compared with the value of the enamel.

The International Oxygen Co., New York City, has recently completed the installation of an oxy-hydrogen generating plant for the United States navy department at the Brooklyn navy yard. The capacity of the plant is 3,500 cubic feet of oxygen and 7,000 cubic feet of hydrogen in 24 hours. The navy yard previously generated its oxygen by a chemical process.

A solution for electro-galvanizing recently patented by Auguste A. Lemetre, Paris, France, consists of the following: Sulphate of zinc, 1 pound; sal-ammoniac, 4 ounces; sulphate of soda, 2 ounces; sulphuric acid, 1 ounce, and water, 1 gallon. Zinc anodes are used with the solution, which is used cold and it is claimed to give an excellent deposit of zinc.

THE BRASS FOUNDRY

Use of Green Sand Cores in Aluminum Work

ONE OF the most noteworthy developments of the foundry industry in the last decade has been the tremendous improvement recorded in aluminum casting practice. The advent of the automobile was a potent factor in promoting this advancement and to meet the requirements of the motor car industry many methods of molding have been devised, and many alloys adapted for casting purposes have been evolved, which, to a large extent, have overcome the difficulties previously experienced from the high shrinkage of this metal. Latter-day tendency is in the direction of specialization in the manufacture of aluminum castings and in large works this white metal department is distinct from the brass foundry. Because of its low specific gravity, different methods must be followed than when casting heavier metals and owing to this dissimilarity in practice many shops in recent years are specializing in aluminum castings exclusively to meet the demands of the automobile trade. However, some builders of automobiles manufacture aluminum castings for their own use. When the Peerless Motor Car Co., Cleveland, erected its new foundry, special provision was made for an aluminum casting department.

Peerless Motor Car Co.'s Foundry

The foundry, which also contains a brass department, is located in a three-story brick, steel and concrete building 53 x 180 feet. The metal vaults, sand mixing plant and casting storage are on the first floor; pattern shop, coremaking and cleaning departments on the second floor and the molding, melting and casting departments are on the third floor. All of the floors are built of hollow tile and reinforced concrete. On the second floor the concrete is overlaid with a wooden floor which is spiked to stringers laid in the concrete. The foundry floor is veneered with brick laid in cement and between the brick and the concrete is a cushion of sand. Light and ventilation are amply provided for by numerous windows and by a gable glass roof extending the length of the center of the shop. This roof is equipped with eight ventilators installed by the Ohio Blower Co., Cleveland. The melting department is separated from the molding room by an 18-inch brick wall shown at the right in Fig. 11. This partition is pierced with wide openings fitted with rolling steel fire doors. The space enclosed is rectangular in form and extends about one-half the length of the shop and one-third of its width. The section of the molding room opposite the furnace enclosure is used for heavy floor work and is equipped with 11 molding machines built by the Tabor Mfg. Co., Philadelphia. These machines are all of the roll-over type and the four power machines are in pits suspended from the girders which support the foundry floor. The machine pits extend into the core department on the floor below, as shown at *A*, Fig. 8. The large machines are used almost exclusively for molding aluminum castings and some very ingenious methods have been devised for molding truck gear cases, six-cylinder crank cases, transmission cases and similar

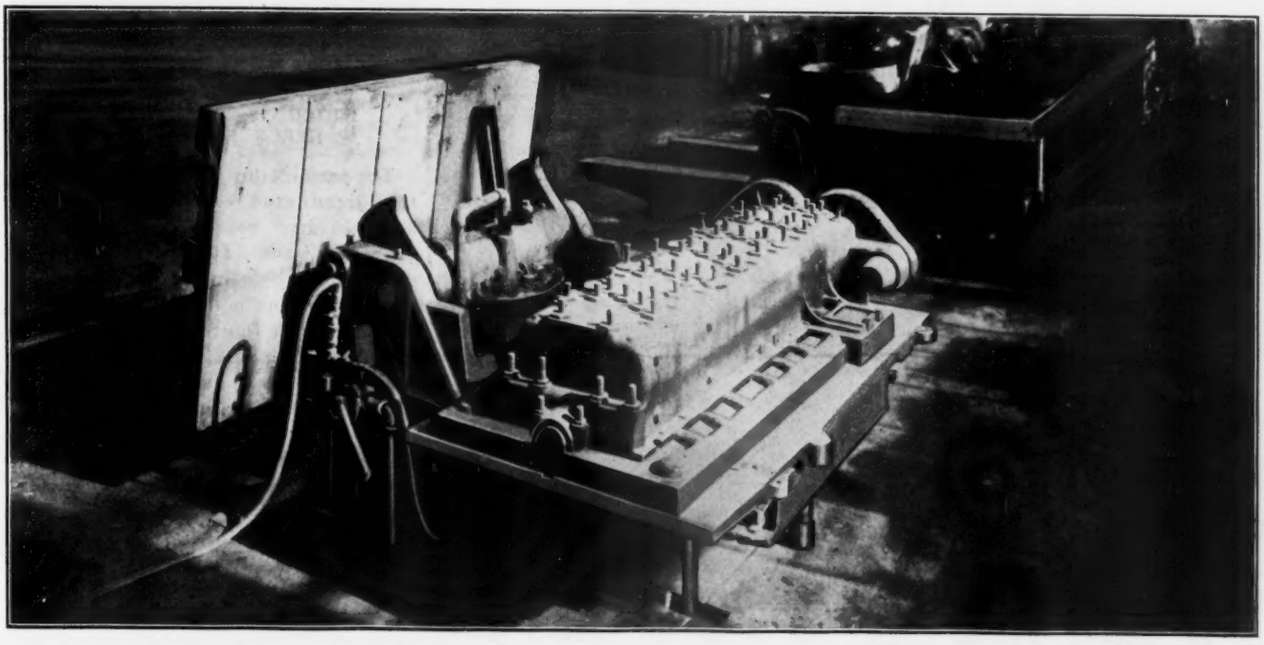


FIG. 1—THE PATTERN FOR A SIX-CYLINDER CRANK CASE, MOUNTED ON A ROLL-OVER MOLDING MACHINE

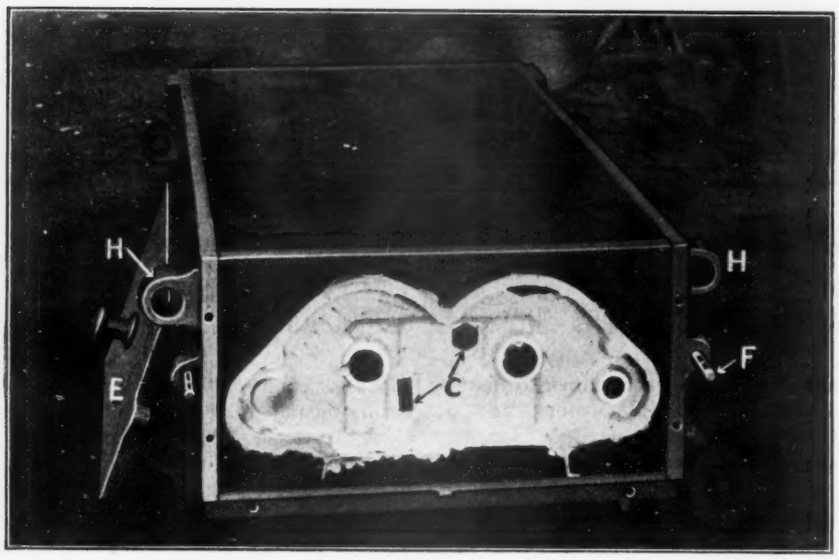


FIG. 2—THE CASTING FOR A SIX-CYLINDER CRANK CASE IN THE MOLD. ONE END SECTION OF THE FLASK HAS BEEN REMOVED

castings in green sand, to avoid the use of large dry sand cores with their attendant troubles.

In Fig. 4 a six-cylinder crank case is shown with the gear case cast on one end. The inside of this casting, with its ribbed partitions and crankshaft bearings, is molded entirely in green sand. Only the small cores are dry sand, such as the round core, *B*, in the gear case end and several oil groove cores which are pinned onto the sides of the large green sand cores that form the inside of the crank case. These castings are molded in aluminum flasks constructed of perforated plates which are bolted together.

Aluminum plates also are used in place of bottom boards, and the crank cases are cast without any drag other than the one formed by the green sand cores. Two machines are used for making the mold, the pattern being mounted on one and the core box on the other. The manner in which the pattern is attached to the table of the machine is illustrated in Fig. 1. The pattern is raised above the table about two inches by a slab core print which extends under the entire pattern. This is shown at *D*, Fig. 1. This slab core print is tapered at the sides to permit of closing the mold without scraping the sand. The slab core is the base of the green sand cores which form the interior of the casting and is practically the drag of the mold.

The core box is made to correspond to the print on the pattern. In this box both the slab core and the inside cores are rammed. The core is rammed by hand in green sand on the machine and is treated like a flask. An aluminum bottom plate is bedded-on and the core box is rolled-over by the machine and is lifted off. The core is formed in six sections, which are separated to permit the removal of the loose pieces of the core box that form the ribs, hubs and other projections on the walls of the chambers, and also to allow the small dry sand cores to be set into their respective positions. After being individually finished, the cores are assembled on the aluminum plate, which is used as the bottom board of the mold. This plate is equipped with ordinary pins and also carries steel dowels to prevent the cope from shifting.

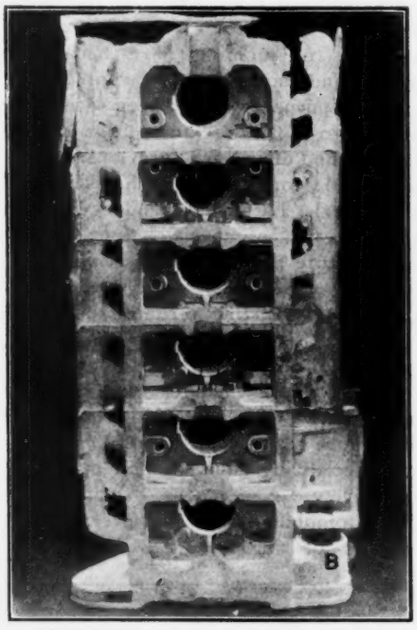


FIG. 4—AN ALUMINUM CASTING FOR A SIX-CYLINDER CRANK CASE, WHICH IS MOLDED WITH GREEN SAND CORES

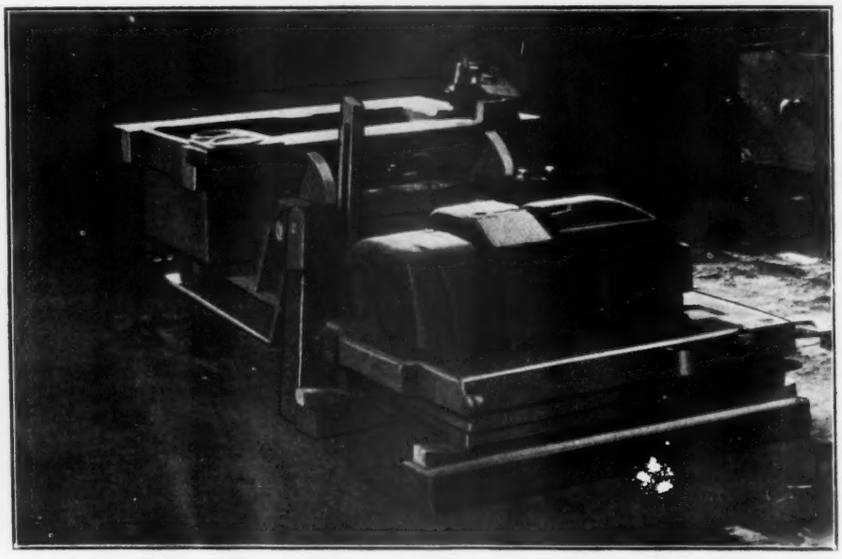


FIG. 3—THE DRAG AND GREEN SAND CORE OF THE MOLD FOR A TRUCK SPEED CASE, AFTER THE REMOVAL OF THE CORE BOX BY A ROLL-OVER MACHINE

To permit the various sections of the green sand cores to be handled as individual cores, sectional plates are used, each of which covers one division of the core. These sectional plates are made of cast aluminum and the large bottom plate is fitted on the sectional plates, after the latter have been bedded-on the core and before the core box is rolled over. After the core box has been lifted off, the part that forms the partitions remains embedded in the cores, as the entire inside of the core box consists of loose pieces. The several sections of the cores are then separated on the bottom plate and the loose parts of the core box are removed. The various sections of the core are then finished and are later

reassembled for the cope. The manner in which the cores are centered in their proper positions with respect to the cope, without any possible chance of error, is ingenious, and the experienced foundryman will realize that herein lies the most important part of the entire molding operation.

Advantages of the Green Sand Core

The accuracy of the castings with particular regard to the positions of the various hubs, bosses and other attachments is more nearly assured by the green sand method than when dry sand cores are used, as the slightest swelling of the dry sand cores, which is difficult to prevent, is accentuated in the casting, and the bosses cannot be centrally drilled. Molded in green sand, the castings also are free from concealed cracks, produced by the unyielding nature of dry sand cores. Each casting is an

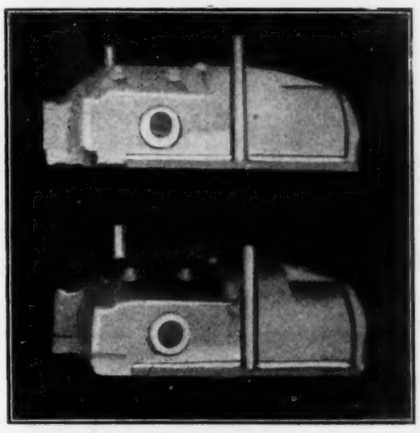


FIG. 5—ALUMINUM CRANK CASE CASTINGS

exact duplicate of the one preceding, as the manner in which the cores are assembled and the mold is closed, preclude all possible chance of inaccuracy, due to particles of sand getting between the cores or the joint, as in such a case the cope would fail to close properly, which would necessitate lifting it off to permit of cleaning the mold. The economy of the green sand method also is apparent, as a large number of coremakers are dispensed with and the cost of drying the cores is eliminated. The cost of machining also is reduced, because of the accurate location of the various parts that have to be drilled, thereby permitting the use of jigs. It is evident, therefore, that while the expense of making the rigging is considerable for the green sand method, it is well justified in cases where large numbers of these castings are to be made.

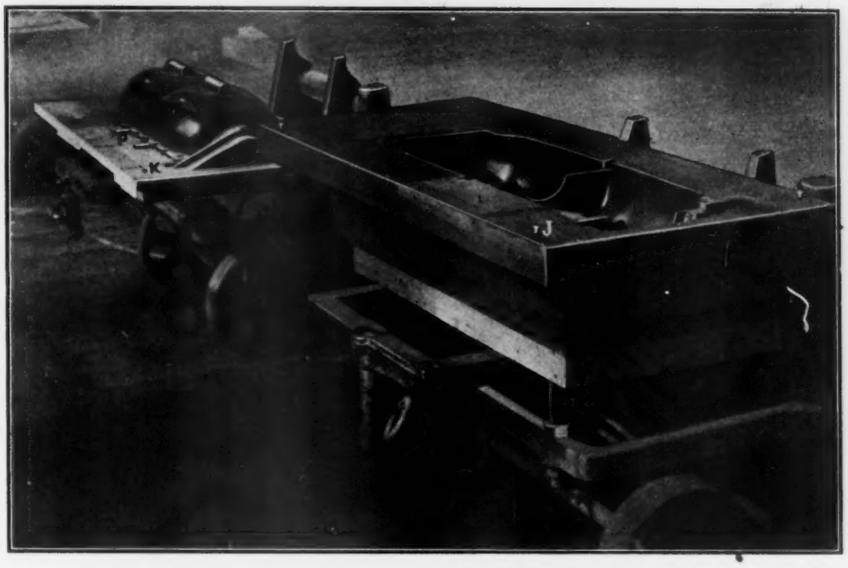


FIG. 6—THE PATTERN AND CORE BOX FOR A TRUCK CRANK CASE BOTTOM, MOUNTED ON A ROLL-OVER MOLDING MACHINE

A large fin is shown around the gate of the casting in Fig. 4. This fin is produced by the light contact between the cope and core to prevent the possibility of crushing the sand joint. The gear case is cast onto one end of the crank case, as shown on the pattern at *H*, Fig. 1, and when the mold has been rammed, this part of the pattern, being loose, is drawn out sideways. While the mold is being rammed, the gear case end is level with the end of the flask, which is removable and is attached by pins in the same manner as a half flask. This loose end is shown removed at *H*, Fig. 2, and is attached to the end of the flask by the pins, *F*. When the mold has been finished and closed over the cores, the loose end is removed from the flask, leaving that part of the mold entirely open, with the dry sand cores projecting, which form the openings shown in Fig. 2. The open end of the mold is next closed by a 3-inch flask which fits onto the pins and is cottered in place. In this end flask is rammed the mold which forms the inside of the gear case with its hubs and depressions, and the mold is made by a separately-mounted pattern. In this manner the use of a dry sand, end core is avoided.

In making aluminum castings, the

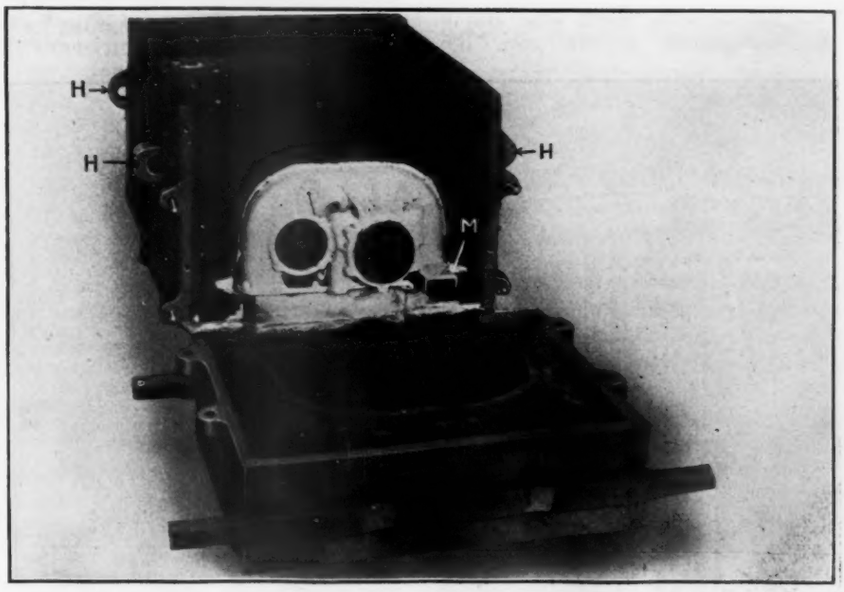


FIG. 7—END VIEW OF THE CASTING FOR A TRUCK CRANK CASE IN THE MOLD AFTER THE END FLASK HAS BEEN REMOVED

FIG. 8—A VIEW OF THE BRASS FOUNDRY CORE DEPARTMENT

extensive use of chills is essential to control the shrinkage of the bosses, hubs and others parts of increased thickness. These chills are not necessarily heavy, as in many cases sheet metal will prevent shrinkage difficulties. The chills used in this foundry are small, octagonal pieces of brass with stems in the center which serve as handles and also as anchors to hold the chills in the sand. The stems are tapered with their smallest diameters at the points of juncture with the discs. In Fig. 1 the chills are shown distributed over the top of the pattern in their proper molding positions. Chills also are used in the cores and are placed in position before ramming. In Fig. 2 the marks of the chills on the casting are shown at *G*.

In Fig. 3 is shown the green sand core for a truck speed case and in the background is the core box mounted on a molding machine. The method of molding this casting varies slightly from that pursued in molding the crank case, as the core is in one piece, the various beads and partitions being so formed that they can be withdrawn as loose pieces. The core, consequently, can be rammed on the drag, in the manner usually employed. The flask is made with a loose end piece similar to the gear case flask. A poured mold with the loose end flask removed is shown in Fig. 5, and the flask, *K*, is shown in the foreground. This end flask is much heavier than the one employed to form the gear casing on the six-cylinder crank case, owing to the projecting flange, *M*, Fig. 5, which necessitates the use of a deeper flask. Fig. 2 illustrates a mold for a six-cylinder crank case after it has been poured and is in process of being shaken-out.

FIG. 10—BRASS MOLDING FLOORS IN THE FOUNDRY OF THE PEERLESS MOTOR CAR CO., SHOWING THE HOPPERS FOR THE DELIVERY OF MOLDING SAND

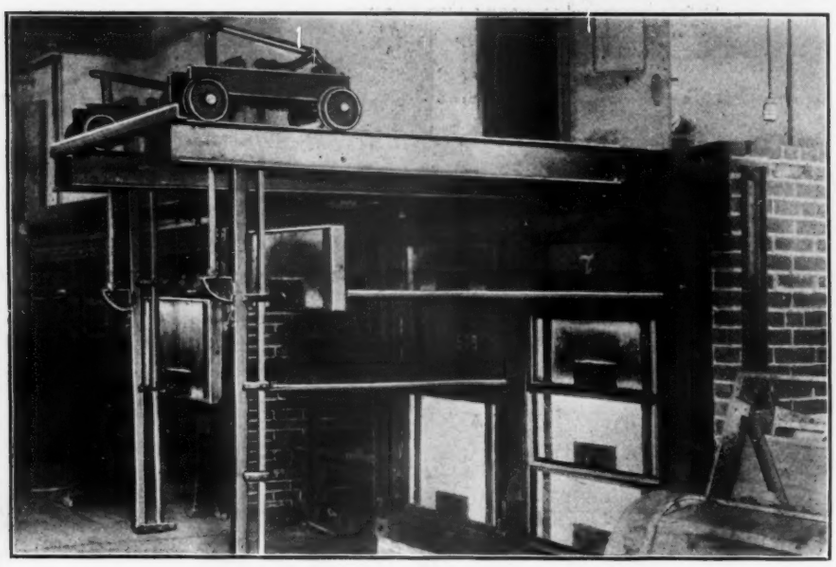


FIG. 9—A BATTERY OF CORE OVENS OF THE ROLLER DRAWER TYPE

The end flask forming the gear case has been removed and the false end used during the ramming operation is shown at the side of the mold. The castings are gated at the joint, as shown in Fig. 4, and are poured from either side. The lugs, *H*, shown on the flasks in Figs. 2 and 5, are merely sockets, into which are inserted pieces of gas pipe to form the handles of the flasks.

Molding Crank Case Core

In Fig. 6 is shown the core box for the bottom half of a truck crank case mounted in a roll-over machine. In the background is the pattern, and it will be noted that it is not raised above the follow-board in the same manner as the six-cylinder crank case, but lies flat on the board. In molding this casting, therefore, a drag is

necessary, and the dowel pins that register the flask are shown at *J*, while the corresponding holes in the pattern board are illustrated at *K*. In molding this casting the drag is fitted over the core box, the loose pieces, *O*, shown on top of the core box, are placed in position and the core is rammed by hand, rolled-over by the machine and the core box is lifted from the drag. The loose pieces are then removed and the core is finished. The cope is then rammed on the other machine, the gates being formed during the ramming of the mold, by laying a straight runner parallel with the pattern and in contact with the branch gates, *P*, Fig. 6. After the cope is rammed, it is rolled over, the pattern is drawn by the machine, the cope is finished, rolled over and closed.

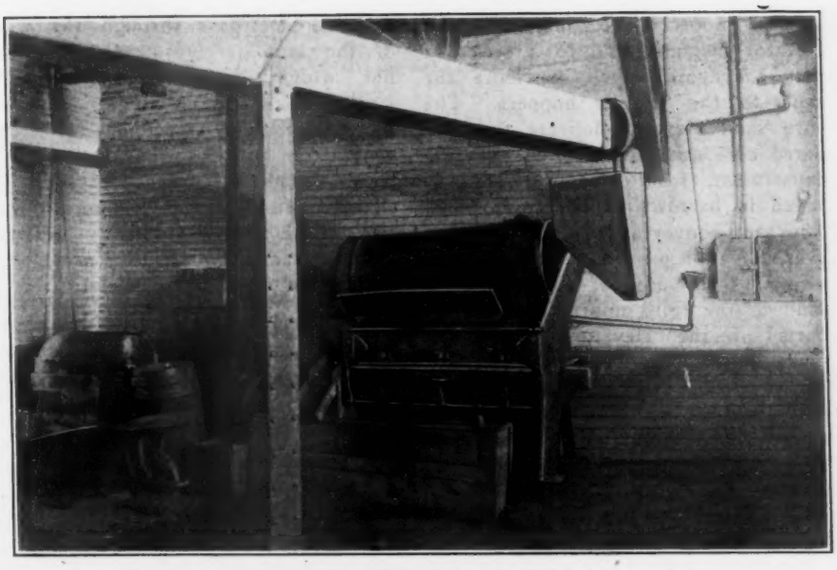


FIG. 12—A VIEW OF THE SAND MIXING MACHINE

Many other aluminum castings are made in addition to those described, and comprise steering spiders, fans, transmission cases, oil pans, etc. The aluminum is melted in four furnaces installed by the J. D. Smith Foundry Supply Co., Cleveland. Two of the furnaces are provided with hoods to carry off the fumes when aluminum borings are being reduced. The furnaces consist of iron kettles set in circular, fire brick-lined shells. They are fired with natural gas, the blast being furnished by a Sturtevant blower. A view of the aluminum melting furnaces is shown in Fig. 11, the two hooded furnaces being at the end of the furnace room. Scrap aluminum, consisting of spilled metal, and also remelted borings, are used for making the aluminum flasks and other equipment. The melting room is equipped with a light traveling crane, from which is suspended a pot pulling quadrant, manufactured by the J. D. Smith Foundry Supply Co.

FIG. 11—A VIEW IN THE FURNACE ROOM, SHOWING THE ALUMINUM MELTING FURNACES

After being mixed and prepared, the molding sand is delivered to the several floors by a conveyor system which discharges into hoppers, *M*, Fig. 10, from which the molders obtain the sand as required. After the molds are shaken out, the sand is discharged into a chute located near the center of the shop and it is carried by gravity to the sand-mixing machine, Fig. 12, installed on the first floor. The mixed sand is discharged from the bottom of the machine and can be directed to the boots of either of two elevators, one for the molding sand and the other for the core sand. As the sand mixer is used for preparing both the molding and core sand, two elevators are required, one terminating in the foundry and the other in the core department on the

FIG. 13—A VIEW IN THE BRASS AND ALUMINUM FOUNDRY OF THE PEERLESS MOTOR CAR CO.

second floor. The molding sand elevator delivers sand to a series of belt conveyors which distribute the sand to the various hoppers. The core sand elevator delivers the prepared core sand to a bin in the core department, from which it is conveyed in barrows to the coremakers. The sand-conveying installation, however, has not proved very successful, owing to the cost of conveying the sand to the third floor. The various parts of the elevating mechanism must be renewed frequently and to eliminate this expense a mixer is being installed on the foundry floor where all the sand will be prepared. From the mixer the sand will be delivered to a short elevator which will discharge its contents into the existing overhead conveyor-distributing system.

Floor Molding Department

The floor molding department is served by a traveling crane of light construction, built by the Brown Hoisting Machinery Co., Cleveland. The crane is equipped with an electrically-operated chain hoist, furnished by the Yale & Towne Mfg. Co., New York. An interesting feature of this crane consists of the extension of the beam carrying the hoist, a distance of about 2 feet beyond the parallel track upon which it travels, so that, in proportion to its length, it has greater strength than if the points of suspension were placed at the extreme ends. The crane is hand-operated from the floor, but the hoisting and lowering are accomplished by power.

The Furnace Pit

A section of the brass molding department is illustrated in Fig. 10. Both sides of this part of the shop are provided with benches, some of which are equipped with squeezer molding machines, furnished by the J. D. Smith Foundry Supply Co., Cleveland. Brass is melted in straight-shaft, coke-fired furnaces, located in a pit or tank with their tops level with the floor of the melting room. The furnace pit is suspended partly from the girders that support the foundry floor and partly from the wall of the building. It extends from the ceiling of the core department a distance of about 8 feet. The space underneath the furnace pit is utilized for the core ovens, Fig. 9. Access to this pit is by means of a door, *N*, Fig. 9, located above the core ovens. The stack and the horizontal flue to which the furnaces are connected are located outside of the building and the internal flues from each furnace pass through the wall of the building into the horizontal flue which is connected with the stack. Coke and metal are delivered to the melting department in steel cars from the basement storage. Ashes from the furnace pit are discharged into a chute opening in the pit bottom and descend by gravity to the basement where they are treated for the recovery of metal.

Core Department

A view of the core department, located on the second floor, is shown in Fig. 8. The core ovens are located at the right and the furnace pit is shown directly above these ovens. Shelves for storing cores are shown in the background and the casting, cleaning and patternmaking departments adjoin the core shop in the order named. As the crank cases and other large aluminum castings are made with green sand cores, the work of the core shop is limited almost entirely to small cores and the coremaking force is small in comparison to the number of men required if dry sand cores were used for the large castings. The cores are transported to the foundry on cars especially equipped with springs to absorb shock and thereby eliminate the danger of breakage. The cores are dried in three large ovens, two containing tracks for core cars, while the third is of the roller drawer type as shown in Fig. 9. The ovens are heated with natural gas and the burners consist of perforated pipes which encircle the walls of each oven.

The casting cleaning department adjoins the core room and is equipped with a band saw, sprue cutter, emery wheels and tumbling barrels. The castings are conveyed from the foundry to the cleaning department by the elevator and after being cleaned are taken to the storage on the first floor. The remainder of the second floor is occupied by the patternmaking department. Artificial illumination is provided by individual tungsten lamps, as shown in Fig. 13. The electric wires, gas and water pipes are carried in a fire-proof shaft located back of the elevator and are easy of access for inspection. A hot air system of heating has been provided.

The Billings-Brown Co., 208 United Bank building, Cleveland, is sending to the trade an eight-page circular which contains numerous testimonial letters regarding the satisfactory use of the parting compound made by this company for gray iron, malleable iron, aluminum, brass and bronze castings.

Crucible Lifting Device

A device intended to eliminate the use of tongs in lifting crucibles from furnaces has been patented by L. H. J. De Bats of Zelienople, Pa. It consists of a fire clay base on which the crucible rests, and which is pushed up to the top of the furnace, carrying the crucible with it. The crucible base is operated by an air hoist, which is placed in the ash pit under the furnace, one end being sunk in the floor of the pit and the other, which carries the base, extends through a circular opening in the bottom of the furnace. When air is admitted to the bottom of the air hoist cylinder, the piston rises and pushes up the base and crucible until the bottom of the latter is level with the top of the furnace. To protect the hoist from the high temperature of the furnace and to prevent the coke from falling through the hole in the furnace as the piston rises, a protector is used consisting of a sheet iron pipe, which is lowered into the furnace around the crucible and is pushed through the bed of coke down to the hoist. The crucible is thus pushed up through this tube, which is subsequently removed.

A German Crucible Furnace

A crucible furnace for melting metals, recently patented in Germany by F. W. Winner, Wiesbaden, is unusual in construction in that it is proposed to suspend some of the crucibles from the roof of the furnace, while others are placed on the bottom, as is customary with regenerative crucible furnaces. The largest size of furnace will contain 45 pots on the hearth with 13 suspended from the roof. The roof consists of alternate removable bungs and arches. The latter are much thicker and stronger than the bungs and are pierced with round holes in which the crucibles are suspended by an external bead or flange around the mouth of the pot, which rests on an annular ledge near the bottom of each hole in the arches. The crucibles on the hearth of the furnace are of the standard type and are accessible when the bungs are removed. The crucibles suspended from the roof extend a sufficient distance into the arch to permit a cover to be placed over them. It is obvious, therefore, that the crucibles cannot be removed by tongs in the usual manner, or by means of the bead on the outside of the mouth. Consequently, a four-pronged tool is used which is hooked underneath the pots.

Results of Manganese Bronze Experiments

The Use of New Metals and Conditions of Molding and Casting Explained--Experiences With Deoxidizers

By C Vickers

MANGANESE bronze, as the term is generally understood, applies to an alloy of copper and zinc modified and improved by small percentages of manganese, iron, phosphorus and tin, and fluxed with aluminum or silicon. Its composition is similar to that of Delta metal, Airch metal, Tobin bronze and Muntz metal, which are all alloys of copper with high percentages of zinc and contain small quantities of iron, tin and sometimes manganese. Manganese bronze is subject to considerable variation in composition, and may be either soft and ductile, or hard and strong. In the former case the tensile strength is low, and the ductility high, while in the latter case these qualities are reversed. It is an alloy very difficult to make to obtain the highest tensile strength uniformly, as the percentage of zinc is the determining factor and, as is well known, this metal is very volatile. Consequently, the tensile strength of the alloy will fall considerably each time it is melted if provision is not made to restore it again to pitch, by additions of zinc to compensate for what has been lost. To adjust the zinc content to its normal proportions involves considerable difficulty, and, as it is better to err on the side of too little zinc than too much, the remelted metal usually shows some falling off in tensile strength as compared with the new alloy.

Use of New Metals

Consequently, when castings of the highest quality are desired it is always advisable to use new metals, as gates and risers, remelted and mixed with new metal are liable to cause a considerable drop in the ultimate strength of the castings. It is not always possible to obtain the same results in tensile strength and elongation in castings made from different heats of manganese bronze, even when the greatest care is exercised to have the proportions of the component parts of the alloy the same, and the melting conditions uniform. Wide variations in the strength of the castings will often be noted, which no doubt are due to slight differences in the working of the furnaces. These are unobservable even to the trained eye, but permit of greater oxidation of the metal in one heat than in another, lowering both tensile strength and elongation. In other heats more zinc will be volatilized, which also causes a variation in physical properties by increasing the elongation at the expense of the tensile strength. As an example of these variations, tests of eight heavy castings are given in the following table:

Number.	Tensile strength pounds per square inch.	Elongation in 2 inches, per cent.
1	70,700	25
2	71,250	26
3	70,660	24.5
4	72,750	29
5	71,500	34.5
6	71,650	32.5
7	77,150	28.5
8	74,900	32.5

Conditions of Molding and Casting

The castings were all made from separate heats with due regard to conditions that would lead to uniformity of results. They were all molded and gated in the same manner and cast, as nearly as could be judged, at the same temperature. All the fractures were classed as crystalline. It will be noted that fairly uniform tensile test results were obtained from the first six castings, although there was a variation of 10 per cent in the elongation. The seventh casting, however, was much stronger and the elongation was also high for an alloy of that tensile strength. Between the seventh and third alloys there is a difference of 6,550 pounds in tensile strength, and 4 per cent in elongation, while the eighth alloy fell off in tensile strength, and, as would be expected, gained in elongation. This was, no doubt, due to a greater loss of zinc, which resulted in a gain of 4 per cent in elongation and a loss of 2,250 pounds in tensile strength. The poor showing of the third alloy was, in all probability, due to the absorption of oxides, as both tensile strength and elongation were reduced. While the elongation of alloy No. 6 is the same as that of No. 8, the tensile strength is 3,250 pounds less, a variation difficult to explain without analyses of the two alloys. This might have been caused by accidental impurities in the metals, or by a slight difference in the temperature at which this alloy was poured. Numerous other causes could be advanced and these would emphasize, further, the importance of careful attention to details when making this alloy, if fairly uniform results are desired.

Many different formulas for making manganese bronze are used, but when the highest physical results obtainable are desired, the alloy must contain the maximum quantity of zinc with the minimum amount of lead. The latter impurity is so potent in reducing the strength of the alloy, that ordinary, commercial brands of zinc cannot be used, as they always contain lead. Therefore, only the purest and best brands should be used. The more zinc contained in the alloy the harder it will be and the higher its tensile strength. An alloy of copper, 52 per cent; zinc, 46 per cent; tin 1 per cent and iron, 1 per cent, when first melted is very hard and brittle, showing that the zinc is too high, and in order to make a strong alloy of this formula, it seems to be necessary to boil out some of the zinc, or to increase the copper. Experiments made to determine the length of time required to boil out sufficient zinc to produce a dense, tough metal from this mixture showed that it cannot be done in less than an hour when using remelted ingots.

Experiments with Deoxidizers

An investigation was made of the effects produced on an alloy of the composition given, by various deoxidizing elements. When working this alloy, the copper was melted under charcoal and the iron was added in the form of tin plate. The zinc was added after the tin plate. The mixture was well stirred and poured into ingots. This mixture gave a very hard metal with a brilliant golden fracture and small crystals. It was low in ductility and could be easily broken. Some of this metal was then remelted and 0.5 per cent of aluminum added. The metal was poured into ingots which were afterwards broken so that the fracture could be examined. The addition of this small amount of aluminum, it was found, made the metal

more fluid, produced the characteristic manganese bronze appearance, changed the color of the fracture to a deeper gold, but did not materially strengthen the alloy. The addition of 3 per cent of 50 per cent ferro-silicon produced great changes in the structure of the original alloy, the metal being hard and stiff and the fracture slate-colored. The metal was both hard and strong. The addition of 3 per cent of 10 per cent phosphor-copper produced a great change in the structure of this alloy. The fracture of the ingot showed long, golden fibers arranged at right angles to the cooled surface of the ingot and extending axially from the center to the circumference. The metal, however, was not greatly strengthened, owing to the fibers running crosswise instead of lengthwise of the ingot. Magnesium, in the proportion of 0.25 per cent gave the alloy a white, steel-like fracture. The alloy was hard, but not tough. Manganese, in the form of 16 per cent manganese-copper, when added in the proportion of 3 per cent, produced no change in the appearance of the fracture of the original ingot, although the manganese was visible externally on the ingot.

When combinations of these various elements were tried in the manganese bronze formula given, it was discovered that phosphorus and silicon should not be used together in this alloy; that phosphorus and magnesium should not be used together, but that aluminum and phosphorus can be used together to great advantage, producing a good alloy having a very close, drab-colored fracture.

BRASS FOUNDRY DIFFICULTIES

Solved by Experts

Crank Pin Bearings

We have an order for a number of crank pin bearings for gas engines, and would like to obtain the formula for a metal that would be suitable for this purpose. The castings will weigh from 40 to 50 pounds each, and should be made of bronze.

The following alloy will be found satisfactory for these bearings: Copper, 85 pounds; tin, 10 pounds, and lead, 5 pounds.

Mixture for Chandelier Castings

We would like to obtain a formula for a brass mixture which will be lemon colored when dipped and is suitable for chandelier castings.

The following alloys are recommended: Copper, 73 per cent; zinc, 25 per cent; tin, 1 per cent, and lead, 2 per cent; or, copper, 64 pounds; zinc, 35 pounds, and lead, 1 pound.

Solder for Soft Metals

Can you inform us what kind of solder is used for soldering such soft metals as pewter and Britannia metal, also the proper flux to use?

Ordinary half-and-half solder is usually employed for the purpose of soldering the easily fusible white alloys, but as the melting points of the solder and the white metals closely approximate each other, it requires skill and dexterity to complete the work without burning a hole in the article that is being soldered. It would be advisable to confine first attempts to unimportant articles, or to practice on thin sheets of waste metal, until some degree of skill has been acquired. The following flux is generally employed in soldering: Chloride of zinc, 1 pint; alcohol, 1 pint and glycerine, 1 pint.

Soft White Metal Pattern Alloys

We would like to obtain a formula for white metal patterns that will have a minimum amount of shrinkage, and will be easy to melt and cast, as well as to finish. What can you recommend for this purpose?

A good casting alloy for making white metal patterns can be made as follows: Melt 60 pounds of lead, bring it to a red heat and add gradually 10 pounds of antimony and when dissolved, stir the mixture thoroughly, remove from the fire and add 30 pounds of tin, flux with a small amount of powdered rosin, stir again thoroughly and allow the alloy to cool to a casting temperature, which can be ascertained by the insertion of a piece of wood, the charring of which should proceed without any great ebulition. The best white metal patterns, however, are made from tin without any addition of lead. The tin should be hardened with copper and antimony, and a good mixture can be made as follows: Copper, 2 pounds; antimony, 15 pounds, and tin, 80 pounds. Melt the copper, add the antimony, followed by the tin. Bismuth is frequently added to white metals to reduce the shrinkage, and one mixture frequently employed consists of 45 pounds of tin; 45 pounds of lead; 5 pounds of antimony and 5 pounds of bismuth. This alloy possesses good casting properties, and melts at a low temperature. All of the above alloys are very easy to finish with tools, in fact they can be cut and scraped with a knife, and by this means small recesses, difficult to reach with files, can be finished in a satisfactory manner.

Silver Bronze

Can you furnish us with any information concerning silver bronze? Why has it been given this name and does it contain any silver?

Silver bronze is merely a trade name and can be applied to any alloy that is white in color. It is distinguished by the adjective silver, because it is supposed to resemble that metal, and not because it contains any silver. The original silver bronze was an alloy of high electrical resistance and its composition was as folows: Copper, 67.5 per cent; manganese, 18 per cent; aluminum, 1.25 per cent; silicon, 0.25 per cent, and zinc, 13 per cent.

Free-Cutting Red Brass

We would like to obtain a formula for a red metal that will be especially easy to machine, of a good red color and not too expensive. We desire a mixture that can be used for pattern

castings and for small work that is finished rapidly on automatic machines.

An alloy that will meet these requirements is made as follows: Copper, 85½ pounds; zinc, 5 pounds; lead, 6 pounds, and tin, 3½ pounds. Melt the copper under charcoal, add the zinc, then the tin, and last, the lead. The metal should appear bright and clean when skimmed, without the least sign of mushiness, otherwise it has not been melted properly and the castings will, in all probability, be spongy. To obtain a fine color it is absolutely necessary to exclude all iron, therefore, if iron skimmers and pokers are used, they must not be submerged in the metal sufficiently long to become strongly heated, or the color of the castings will be ruined.

Smith's Bearing Bronze

Can you furnish us with any information relative to the composition of Smith's bearing bronze? We understand that a flux was used in making the alloy that conferred upon it peculiar properties for bearing purposes.

According to the patent specifications this metal was made by adding an alloy of zinc and tin to molten copper. The proportions of the white metals were tin, 80 pounds, and zinc, 20 pounds and in making the alloy a flux was used consisting of 1 pound of salt and 1 ounce of potash. Four ounces of this flux were charged with the zinc, and after the tin was added, the mixture was stirred thoroughly and poured into ingots. The bearing alloy was made by melting 80 pounds of copper, and adding 12½ pounds of the tin and zinc alloy. What effect the flux had on the mixture is difficult to understand.

A Strong and Cheap Alloy

We have a number of castings to make that require a stiff metal. The mixture must be cheap and we cannot use red metal as it is too expensive. We are practically confined to the copper and zinc series of alloys, but another difficulty arises, as these alloys, when high in zinc, are usually tough, and the castings to which we refer must machine easily. What we want is a strong, stiff metal, that will machine fairly well, and we will esteem it a great favor if you could suggest anything that would probably serve our purpose.

The following alloy will be found to meet all the requirements you mention: Copper, 57 pounds; zinc, 38 pounds; lead, 1 pound, 6 ounces; iron, 5 ounces; aluminum, 5 ounces; 80 per cent ferro-manganese, 2 pounds, and tin, 1 pound. Melt 27 pounds of the copper, under charcoal; bring to a milky white heat; add the iron in the form of tin plate; flux with a little soda ash and stir thoroughly to make sure that the iron is all dissolved, then add the ferro-manganese in the powdered form. Close the furnace for 10 minutes and at the end of this period the manganese should be dissolved. Then add the balance of the copper in such a manner that the molten metal in the crucible will not be chilled. After the copper is melted, stir well and add the aluminum, next the zinc, then the lead and tin. This alloy will be found to be very stiff, strong and cheap, and at the same time very fluid. It is, therefore, better adapted for making the castings you mention than red metal would be, as it does not have to be poured either so hot or so strongly in order to obtain good castings. Both the ferro-manganese and iron may be omitted if thought desirable, and a stiff alloy will result. The addition of these elements, however, undoubtedly improves the alloy as they increase both strength and density.

Brass Molders' Tubs

Can you give us the dimensions of brass molders' tubs, the kind of lumber used, and the method of construction?

Brass molders' tubs are usually made from 2-inch, undressed pine lumber, although the boards for the front of the tubs should be dressed on one side. The lumber should be 12 inches wide for the front, back and ends of the tubs and two boards superimposed on edge are required. The tub will then be 24 inches deep. The front of the tub is inclined toward the bottom so that the molder can work with comfort. The two ends should be made first and should consist of two boards, 12 inches wide, cleated together. Each end should be about 32 inches wide at the top, and 26 inches wide at the bottom. The sides are spiked onto the ends, the length of the trough being 10 feet. After the frame of the box has been made by spiking the sides and ends together, the bottom can be attached. This can be made of three 10 x 2-inch planks, cleated together like the bottom board of a flask, and then spiked on to the frame of the tub. As the bottom of the frame is 26 inches wide inside, the three 10-inch planks will cover the bottom flush with the outer edges of the sides, thus allowing the bottom to be spiked into the sides of the frame. The bottom should not be spiked too firmly, in view of the fact that renewal will be necessary in about two years, and the sides may outlast two bottoms.

The life of the tub can be greatly prolonged by covering the bottom and 12 inches of the sides with sheet zinc. The bottom should be covered before it is spiked onto the frame and the zinc should be as wide as the bottom so that it will be securely fastened when the bottom is spiked in place. If the zinc can be placed on the bottom and held securely without nailing, it will be more satisfactory, as the molder's shovel is liable to catch under the heads of the nails and tear them out. On the inside of the tub, front and rear, are nailed two cleats to form a ledge on which the skids that support the molds are rested. These cleats are formed of two lengths of 2 x 4-inch lumber, and they are nailed to the inside of the tub at a depth of 5 inches from the upper edge. The skids are short lengths of 2 x 4-inch stock, one edge of which is beveled to fit the incline of the front of the tub. The skids are not nailed to the cleats, but are simply rested thereon, and are thus adjustable to any length of followboard, and permit the molding to be carried on at any point along the length of the tub.

The tub should be elevated from the floor and should be supported by 4 lengths of 8 x 2-inch lumber set edgewise on the floor. The tubs should be set 10 inches from the wall, to permit of a tool shelf, 12 inches wide, to be attached to the back of the tub. This shelf should be supported by brackets nailed to the back of the tub, and the end of the horizontal arm of the bracket is recessed into the edge of the tub and nailed. This permits the shelf to be fastened tightly along the upper edge of the back of the tub.

Flux for Yellow Brass

Can you inform us what kind of a flux is best adapted for use in melting yellow brass scrap for plumbers' supplies? Would borax be of value and, if so, how should it be used? We are using 10 per cent phosphor-copper in our red brass with very good results, and would like to know of something that will accomplish the same results with yellow brass.

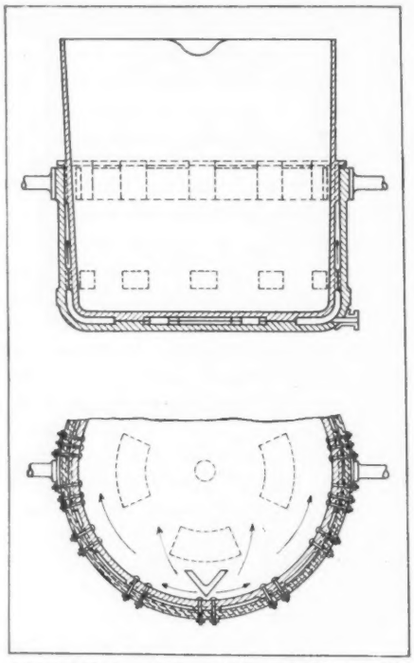
Unless you are troubled with pin holes in the castings, there is really no need for the use of any flux in melting yellow brass, either in the form of scrap or as a new alloy. If the metal skims clean, your melting practice is satisfactory and the castings, if properly poured, will be sound and clean. Yellow brass, especially for plumbers' goods, should

not be poured too cool, and the metal should be poured more strongly than in the case of red brass. It is always advisable to keep the head of the sprue filled with metal in order to prevent the zinc oxide, or smoke, from entering the mold and producing wormy castings. If you find pasty metal on top of the pot when skimming the metal, it shows that it has been overheated or oxidized while melting, and the casting will be unsound. In this event, you probably are neglecting the use of charcoal, but if this is not the case, the metal is not being given sufficient attention while in the furnace. Borax can be used as a flux, and is always of value in melting non-ferrous metals. It may be added to the copper when it has just become molten, but the borax should not be stirred until it has had time to heat sufficiently to drive off the water of crystallization, otherwise an explosion may follow. A flux that will be found of value for yellow brass follows: Oxide of manganese, one part; bottle glass, two parts; charcoal, one part, and sal-ammoniac, one-half part. To avoid porosity, use manganese-copper in the following manner: Melt 5 pounds of 30 per cent manganese-copper with 6 pounds of ordinary copper, and when liquid, add very gradually 10 pounds of zinc Use from one-fourth to one per cent in the metal, the amount being determined by the appearance of the castings, which should not be black, but yellowish brown. For small castings, aluminum is extensively used in the proportion of from two to four ounces to 100 pounds of metal.

A Jacketed Foundry Ladle

A patent has been granted M. Albuetz, 29 Ashley road, Crouch Hill, London, Eng., for a jacketed ladle for use in iron and steel foundries pouring large castings. If a foundry has an order for a casting weighing 8 tons, but if the cupola only melts from 4 to 5 tons per hour, it would require nearly two hours to melt this quantity of iron. The greater portion of this metal would have to be stored and accumulated in some suitable vessel and would have to be maintained at the same temperature as when it was tapped from the cupola. This is accomplished in most foundries by accumulating the iron in the bottom of the cupola, in a cupola receiver or metal mixer, or in an ordinary foundry ladle.

Although each of these three methods affords storage for the accumulating of molten metal, none has any provision to maintain the metal at the temperature at which it was tapped from the cupola. Accumulating the molten iron in the cupola, if it is not provided with a receiver, frequently leads to serious consequences. The tuyeres in the cupola in which a large amount of iron is to be accumulated will have to be placed higher than ordinarily, and as the coke bed should extend at least 18 or 24 inches above the tuyeres, it is apparent that for every heat, from 400 to 500 pounds additional coke will be required on the bed. Furthermore, if a large quantity of metal is to be accumulated in the cupola the level of the melting zone will be raised, and after the metal has been tapped the melting zone will again be proportionately lower. As a result, the



SECTIONAL AND PART PLAN VIEWS OF A JACKETED LADLE

metal in the bottom of the cupola, far below the tuyeres, receives no further heating. On the other hand, this molten metal can be held in an open ladle for a considerable time at the same temperature and in the same condition as in the cupola, provided the metal is covered with charcoal. These facts have been proved by Dr. Edward Kirk, the well-known authority on cupola practice.

Receivers

Cupolas equipped with receivers are employed extensively. These vessels perform two duties, namely to accumulate the molten metal, and they also act as a mixer to obtain a more uniform mixture from the various charges. The receiver should maintain the molten metal at the same temperature at which it was tapped from the cupola, or at least it should prevent the chilling of the molten metal. In the usual type of receiver, provision is made to keep the top, that is the space above the metal, at a certain temperature. The heat generated in this portion of the receiver, however, is of little importance, as the chilling action and lowering of the temperature of the metal begins at the bottom of the receiver and around the walls. These regions, however, are without provision for a further heat supply. When the metal is tapped from the receiver into the pouring ladle, the temperature is still further reduced and in many instances the metal is not suitable for light work.

The Jacketed Ladle

From the foregoing it becomes apparent, that in many instances a device, which would not only serve as a receiver, but also as a pouring ladle, not only for accumulating the molten metal, but for maintaining it at approximately the same temperature as when tapped from the cupola, would prove of great value. A ladle which will meet these requirements is shown in the accompanying illustration. This ladle is made of cast steel and is surrounded up to the level of the trunnions with a jacket. The space between the jacket and the body of the ladle varies from 1 to 2 inches. Into this hollow space a continuous supply of hot gases is introduced. These hot gases are obtained from the cupola or from some type of mold dryer. This hollow space likewise extends over the entire area of the ladle bottom, with the exception of a few points provided for supports. These supports are cast onto the ladle jacket, respectively, and are machined off to insure the uniform setting of the ladle. The comparatively narrow space between the ladle and the jacket does not impair its strength, and two rows of facings around the ladle impart additional strength, particularly when the ladle is tilted for pouring. The gases can escape through an opening similar to the inlet, or openings can be spaced at uniform distances around the ladle between the flange and the top of the jacket. The trunnions which are provided with the usual gearing for tilting the ladle are bolted to the jacket. The ladle is also provided with a cover which is not shown in the accompanying sectional and part plan views. This type of pouring ladle and receiver can be made in sizes from 3 to 25 tons capacity. The temperature of the gases introduced into the space

between the jacket and the ladle will average from 400 to 500 degrees Fahr. and, therefore, the metal can be accumulated for a period of several hours without chilling. A casting, for example, weighing 15 tons could be poured from a jacketed ladle of this kind even if the cupola were melting only at the rate of from 4 to 5 tons per hour. By means of a well-regulated mold dryer, 10,000 cubic feet of air can be heated to 500 degrees Fahr. per hour, which would require not more than 28 pounds of coke. For a 15-ton casting, therefore, approximately 100 pounds of coke would be used.

A Practical Pattern Storage System

By H. N. Tuttle

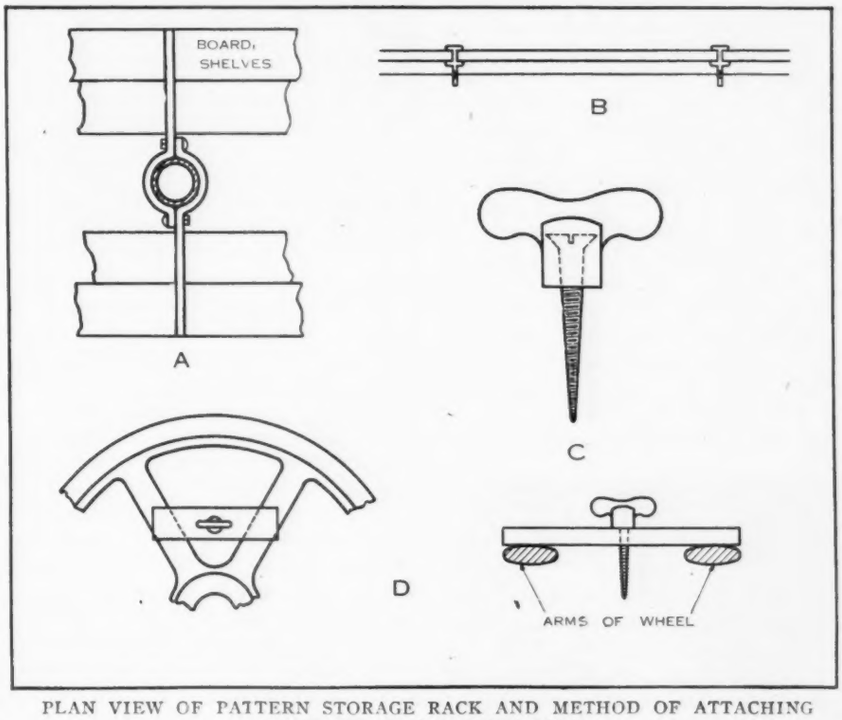
After a manufacturing plant has been in operation for a number of years and several thousand patterns have accumulated, many of which are used only for occasional repair orders, it usually becomes necessary to re-arrange the system of pattern storage. As the care of the patterns usually becomes a great burden, it is essential to install a system which will provide for both their convenient storage and easy location in the pattern vault. The plan that will be outlined was adopted by a large company and has proved exceedingly satisfactory.

This system provides for the usual method of numbering and lettering the patterns and when arranging the shelves, ample space was allotted for patterns carrying one letter. The shelves are wood and are supported by iron brackets bolted to steel pipe, as shown in the plan view, *A*, in the accompanying illustration; *B* is a longitudinal view of one shelf which is made of ⅞-inch boards and is supported between the ribs of the bracket. The patterns, attached to the follow-boards, are placed with their core boxes upon the shelves in numerical order and to facilitate their identification, a card is tacked upon the edge of the shelf underneath the compartment in which the pattern is located. The number and letter are printed in black upon white paper and can easily be read at some distance. When the pattern is too large for the compartment assigned to it, the card remains in position on the edge of the shelf, but, in addition, its other location is noted. For example, a pattern too large for compartment *241 B* would be removed to another shelf and the following notation would be made on this card, *See Section C, Shelf 3.* If the pattern is in the pattern shop for repairs or alterations a notation would be made upon the card referring to the pattern shop record for information as to the present location of the pattern.

So far as possible one pattern is made to serve for several similar castings either by changes on the pattern itself or by subsequent slight machining operations. In the case of a pattern of this kind, the letters *C. N. O.* are printed on the cards attached to the pattern compartments, which indicates to the foundryman that the pattern number only is to be changed. On pulleys it is common practice to change the number when the core prints are changed for a different casting, in which case, on the card under the pattern number, the following notation will be made, *Change Prints and Number.* If the change on the pattern is so complicated that it cannot be readily made in the pattern storage, a notation on the pattern compartment card will indicate that the pattern is to be sent to the pattern shop for the desired change.

Loose pieces for pattern changes are numbered and are located in suitable compartments. These loose pieces are delivered to the pattern shop with the pattern. Other cards with instructions for changes in these patterns are provided as a cross-reference. Occasionally, one pattern will serve for a large number of different castings and frequently as many as 15 different castings are obtained from one bevel gear by merely changing the hubs. All of the necessary data for these pattern changes are noted on cards and in instances of this kind these cards are somewhat longer than those customarily used. If a pattern is used on a molding machine, this fact is prominently noted on the card. To reduce the manufacture of core boxes to the minimum, a correct record is maintained in the pattern shop of all core boxes that can be used for a number of patterns. If the core for a pattern can be made in a box previously made for another pattern, this fact is noted upon the identification card. It is the duty of the pattern carrier to attach the cards to the shelves, but special cards are filled in by the patternmaker.

New patterns are usually made of wood, and as these are frequently replaced by metal patterns, the card for the new pattern which subsequently must be replaced is not firmly attached to the shelf. Only cards for patterns in use a year or more are permanently tacked in place. Patterns for gray iron castings are delivered only to either the foundry or the pattern shop and when taken to the latter department, the letters, *P. S.*, are written on the shelf with chalk. The shelf, however, is not marked when the pattern is delivered to the foundry.



PLAN VIEW OF PATTERN STORAGE RACK AND METHOD OF ATTACHING PATTERN TO FOLLOW-BOARD

In addition to the card system, a record of all patterns is entered in a book, in which suitable notations are made as follows:

121 L—Aluminum patterns, gated, 2 pocket cores.
122 L—Single iron pattern, 1 round core.
123 L—Single wood pattern, center core—Outside made in chill.
124 L—Made by putting 3-inch core in 47 D, also add three lugs on rim.

Heavy patterns and those most fre-

quently used are located near the elevator, while dead patterns or those used only occasionally, as well as patterns for shop castings, jigs, tools, flask patterns, etc., are located in the second story of the pattern storage vault.

Patterns Shipped to Outside Shops

As this plant manufactures only gray iron castings, a large number of patterns must be carried in stock which are shipped to outside foundries for steel, malleable iron, and brass castings. The most of these patterns are in outside shops the greater part of the time. These are known as transient patterns and one section of the pattern storage has been set apart for them exclusively. These patterns are stored without regard to number or letter, but when a pattern is placed in a compartment, a note of its location is made on the shop pattern record. If the pattern is placed on shelf *3*, division *A*, the notation on this record would be *3-A*. When the pattern is shipped to an outside shop, this notation is erased. Patterns for shipment are packed in the pattern shop, where they are carefully inspected for repairs or changes and care is exercised to include all of the necessary parts such as core boxes, gages, loose pieces, etc. The patterns and their attachments are placed on a table and the list of the pattern parts is carefully checked. By this method of procedure it is practically impossible to ship incomplete patterns to an outside shop.

Pattern Shipping Record

A pattern shipping record is maintained by the patternmaker. If pattern, *123-A*, was shipped to the Inland Steel Co.'s foundry on Jan. 26, 1912, and returned on Feb. 10, 1912, and was shipped again to the Western Steel foundry on Feb. 15, 1912, this record would be entered as follows:

123 A—I. S., 1/26/12; R., 2/10/12; W. S., 2/15/12.

After the patternmaker has prepared a pattern for shipment a list of all of the parts is made, together with a carbon copy which is forwarded to the shop receiving the pattern.

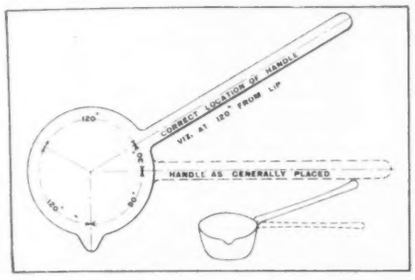
The greatest difficulty was experienced in storing the patterns for various kinds of wheels which vary in size from 9 inches to 6 feet in diameter. It was also necessary to store the follow-boards with the wheel patterns and the plan ultimately adopted provided for fastening the pattern to its follow-board. The pattern and follow-board are then rolled into a rack. To fasten the patterns to their respective boards, thumb screws are provided, as illustrated at *C*, which consists merely of a winged head cast onto a wood screw. At *D* is shown the method of adjusting the wheel pattern to the follow-board. Flask patterns are numbered with white paint and these are stored invariably in racks remote from the elevator or on the second floor, as they are seldom used and occupy considerable space.

How to Avoid Pin-Holes in Iron Castings

By N. W. Shed

Question:—We are experiencing considerable trouble from pin holes in our castings, which develop after machining. We would like to know the cause of these pin holes, which are not the result of dirt or slag. In a good many castings these holes are perfectly clean and have a blue, metallic luster.

Answer:—The pin holes referred to are blow-holes formed by gas bubbles. The iron is slightly oxidized by the



blast and a reaction takes place between the carbon of the iron and the oxygen, thereby generating a small amount of gas. If the metal is hot and fluid the gas bubbles escape before the metal cools and the casting will be solid. If the metal is dull the gas bubbles are imprisoned. If there is oxidation in hot and fluid metal, blow-holes will be found in the casting. The customary method of preventing oxidation is to employ as low a blast pressure as possible and at the same time to use a slight excess of coke. If spiegeleisen or ferro-manganese is added to the charge, the oxidation of the iron will be considerably reduced. The manganese is oxidized first and passes into the cinder. Ferro-titanium, ferro-silicon and ferro-vanadium are powerful deoxidizers and a small quantity added to the stream of iron as it flows into the ladle will remove the oxide of iron from the metal. In your case it might be advisable to add a small amount of powdered ferro-silicon in the ladle and to have the metal hot while pouring the molds.

American Institute of Metals

At a recent meeting of the executive committee of the American Brass Founders' Association, it was decided to submit for the approval of the membership, a change in the name of the organization. The American Institute of Metals is preferred to the present name, which does not adequately describe the scope of the association. Another change in the constitution has been recommended which will permit of holding the convention at a time and place to be selected by the executive committee. The constitution at present provides that the association shall meet each year in convention at the time and place that the annual meeting of the American Foundrymen's Association is held. While it is not the intention to hold the annual meetings of the association at a time and place other than those of the American Foundrymen's Association and the Foundry and Machine Exhibition Co., the executive committee did not consider it wise to have the association bound by a constitutional provision covering the annual meeting.

Foundry Ladles

By M. W. Woods.

An improvement in foundry ladles that I would like to suggest consists of changing the location of either the handle or lip, so that the natural gravity point for the metal cast from the ladle would make it easier to pour. The handle would thus be located 120 degrees from the lip, instead of at 90 degrees as at present, which, as far as I have observed, makes it difficult for a man to handle a ladle full of metal, because it is necessary to stoop to bring the handle to a horizontal position before the metal will leave the lip without overflowing on one side. The accompanying illustration clearly outlines this suggestion, and in the case of hand ladles for iron, can be easily accomplished by slightly twisting the ladle in the ring.

The Henry Souther Engineering Corp., Hartford, Conn., has prepared a 12-page booklet which contains notes and useful data on the selection and preparation of samples for analysis and tests. The pamphlet suggests methods for sampling brass, bronze, aluminum alloys, iron castings, steel, coal and coke and reproduces physical test specimens adopted by various technical societies.

Control of Mixtures for Cast Iron Car Wheels

A Discussion of the Advantages of the Microscope in Car Wheel Practice and Some Remarkable Examples of Cast Iron Chills

By Asa W Whitney

AS A car wheel maker, the recurrent discussion of the percentage of charcoal iron in car wheels is interesting, particularly criticisms of metallurgical practice. A statement recently published, to the effect that 20,000 car wheels are made daily in the United States and Canada, seems to overrate the production, if only 23, 30 and 33-inch wheels are included in the total. While I have never seen any statistics covering car wheel output, but assuming 400 pounds is the average weight of car wheels, which includes the lightest mine wheels and the heaviest standard wheels from 50 to 750 pounds in weight, it would seem that the possible maximum capacity per day is 4,000 net tons. This is based on an output of 20,000 wheels per day, including all sizes of car wheels, and estimating 300 working days per year, the total car wheel tonnage would aggregate annually 1,200,000. Assuming that the charcoal pig iron produced in 1911, not including cold blast iron, was 400,000 tons, it is probable that not more than 80 per cent was available for wheel mixtures or approximately 320,000 gross tons. Assuming that the output of car wheels in 1911 was more than 1,200,000 net tons, it follows that approximately 30 per cent of this iron was available for the total car wheel iron mixtures. It is unlikely, however, that more than 80 per cent of the car wheel tonnage in 1911 contained any charcoal iron whatever. My contention is that it was not required for making chilled wheels and was consumed in other practice.

FIG. 1—SCRAP MIXTURES, SHOWING CHILLED FRACTURES OF TEST BARS

FIG. 2—CROSS-SECTION OF BAR MADE FROM A SCRAP MIXTURE, REDUCED ONE-HALF

Mileage of Wheels

At one time, 75 per cent or more of the cold blast charcoal iron output was used in wheel mixtures, but since that period the mileage of the wheels in most severe service has dropped to about one-third the maximum of former days. This, however, is offset by the following:

Doubling the weight of the wheel did not double the area of contact with the rail.

When a high percentage of cold blast charcoal iron was used in wheel mixtures, the loads were about one-fifth and the speeds about one-third as great as they are today. Therefore, the shock and wear on the treads and flanges was much less in former days, especially since the rails in use were made either of wrought iron or soft steel. Today the steel used in the manufacture of rails contains from 75 to 100 per cent of pearlite and is frequently hardened by alloys. The more rigid roadbed of today also increases the shock on the flanges and treads wherever the slightest imperfections of the rail or wheel exist.

Ample evidence of the superior physical properties of cold blast pig iron as compared with hot blast iron is available and care should be exercised in remelting to preserve the proper superiority of cold blast iron. To promote the use of warm and hot blast charcoal iron, every effort has been made by foundry chemists and metallurgists, and today these grades, to a large extent, are eliminated in favor of other grades of iron, which are physically inferior to hot and cold blast charcoal.

The next step in the development of car wheel practice consisted of the addition of powdered ferro-manganese in the ladle. This was done by Alexander E. Outerbridge at A. Whitney & Son's car wheel works, at Philadelphia. The powdered ferro-manganese was added to the metal in a 600-pound wheel-pouring ladle while it was being filled from an 8-ton iron mixer, which received concomitant and consecutive taps of metal from three cupolas. Strange as it may seem, the mixer was patented years later and applied in the steel industry. In 1888 I discontinued adding ferro-manganese to wheel iron in the ladle, except for emergencies and for lighter wheels for which the cupola metal was not especially intended. Later, however, I adjusted all mixtures separately

FIG. 3—EXAMPLES OF CAR WHEEL CHILLS

FIG. 4—MICRO-PHOTOGRAPH OF SAMPLE B

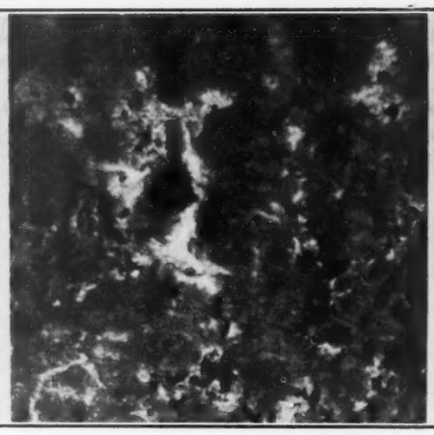


FIG. 5—MICRO-PHOTOGRAPH OF SAMPLE B, COOLED MORE SLOWLY THAN METAL SHOWN IN FIG. 4

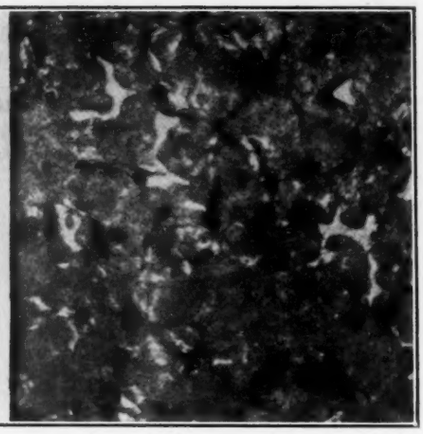


FIG. 6—MICRO-PHOTOGRAPH OF EXCEEDINGLY HARD IRON, CONTAINING 57 PER CENT CEMENTITE AND 43 PER CENT PEARLITE

and more accurately for light and heavy wheels, seldom having recourse to ladle dosing, which has serious disadvantages in small amounts of cooling iron. Since 1890 I have added ferro-manganese and other alloys to the cupola charge, the mixture being carefully adjusted for every purpose. This same practice prevails today for all classes of castings, both chilled and soft.

The composition of the metal must be varied with the weights and cross-sections of the wheels which govern the rate of cooling and the consequent grain size of the ferrite, pearlite, cementite and graphite. These are essential structural elements. In the early days of car wheel manufacture, with the manganese below 0.30 per cent, the specification for sulphur provided for less than 0.08 per cent. Today, notwithstanding the higher manganese content and the heavier wheels in use, 0.17 to 0.19 per cent sulphur is the maximum and 0.25 per cent sulphur is out of the question. The attainment of metal especially low in sulphur, the use of any one brand or grade of iron and the use of steel because of its strength or the facility with which either high or low carbon metal may be obtained, will not insure the highest quality in chilled or in any other kind of iron castings, where varying physical and market conditions must be met. I, therefore, will direct attention to the enormous difference in physical properties due to minute differences in the chemical analyses. At one time it was believed that the chemical analyses of car wheels would not afford a sufficient clue to the resultant enormous differences in physical properties. The causes for these differences, however, have been cleared by metallography.

Table I.

	Good wheel per cent.	Poor wheel per cent.
Combined carbon	0.54	1.17
Graphitic carbon	3.30	2.36
Total carbon	3.84	3.53
Silicon	0.69	0.65
Manganese	0.13	0.12
Phosphorus	0.43	0.52
Sulphur	0.12	0.19

Chemical and Physical Properties Compared

In 1888 the late Dr. Dudley made a report upon two Pennsylvania railroad, standard size car wheels, which was published in the *Charcoal Iron Workers' Journal*, Vol. 7. The good wheel, before breaking, was subjected to 150 blows with a 25-pound sledge, while the poor wheel was broken with eight blows. The analyses of these wheels are shown in Table 1.

At that time attempts at proximate analyses were not very satisfactory, and I understand that my calculation of proximate compositions on chemical data and of structure on metallographic principles, published in the proceedings of the American Society for Testing Materials in 1902, page 203, afforded the first explanation on an entirely practical basis. My recommendations, however, were considered too radical for those who believed that strong iron could not be made from the most plentiful and convenient melting materials which can be skillfully adjusted to give any required physical structure at the lowest net cost.

The more nearly the chemical and physical properties of the melting stock approximate those of the product, the more difficult it becomes to carry high percentages of the product as scrap or to carry a high percentage of steel and cheap iron with high chilling strong metal, notwithstanding the use of alloys. Railroad car wheels must have an accurately adjusted composition for each class or weight and the structure must be and can be better adjusted to afford more regular results than are obtained at the present time. Mixtures for iron castings as well as steel should be made and melted on a scientific basis. The scrap, pig and alloys should be selected entirely with reference to every stage of the process to obtain a molten metal of such composition that will separate suitably into the desired proportions of the structural components required.

The proximate compositions of the two wheels previously referred to will

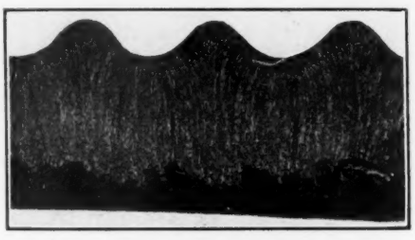


FIG. 7—THREE-INCH CHILL ON CRUSHER JAW

be omitted, but the structural compositions are interesting and are as follows:

	Good wheel per cent.	Poor wheel per cent.
Pearlite	67.31	86.880
Excess ferrite	26.514	none
Carbon as graphite	3.30	2.36
Fe S	0.121	0.329
Fe_3 P	2.755	3.322
Excess cementite	none	7.10

The good wheel had a steel and iron structure while the poor wheel was harder and was practically a weaker steel, the strength of which was still further reduced by excess cementite.

Another interesting comparison of two mixtures of iron which developed widely varying physical properties

proved our previous contention with reference to making these mixtures. The analyses of these two mixtures are given below:

	A	*B*
	Per cent.	Per cent.
Combined carbon	0.530	0.49
Graphitic carbon	2.907	2.21
Total carbon	3.437	2.70
Silicon	1.05	1.786
Manganese	0.395	0.822
Phosphorus	0.04	0.615
Sulphur	0.015	0.10
Copper	0.02	none

The structural compositions of *A* and *B* follow:

	A	*B*
	Per cent.	Per cent.
Pearlite	66.2	61.337
Ferrite	30.817	32.518
Fe_3P	0.286	3.935
Graphite	3.06	2.21

Sample *A* consisted of a 2-inch square bar, 13 inches long, planed from the center of cheap coke pig iron, costing $13 per net ton. A test bar made from the 2-inch square bar turned to 1 inch area and ½ inch in diameter at the center, developed a tensile strength of 37,700 pounds per square inch.

Sample *B* was made of 97 per cent scrap, mixed with 3 per cent of alloys and cost $12 per ton. It was used for brake shoes and similar work. The test bar had an area of 4 square inches and was 15 inches long. Bar *A*, 1 inch area at the center, developed a tensile strength of 35,840 pounds per square inch. A micro-photograph of a section of sample *B* is illustrated in Fig. 4. This shows the pearlite, ferrite and graphite. The phosphide of iron is visible in the ferrite in some places.

The miscroscope affords an easy method of ascertaining the structural composition. In samples *A* and *B* is found a good steel structure in both cases, but sample *B* is hardened and weakened by iron phosphide, notwithstanding the fact that it contains a lower percentage of graphite than *A*. Furthermore, the graphite is in a less harmful condition than that contained in *A*. A comparison of these analyses immediately indicates the best composition, which is attained at a lower cost.

Use of Ferro-Alloys

In my practice I frequently avoid all ferro-alloys, but use them occasionally for making hard mine wheels with light spokes. The amount of steel scrap is varied and while these wheels are guaranteed for five years, they are in service from 10 to 20 years. An analysis of this metal was pronounced by a chemist of wide experience in car wheel work, as wholly unfit for anything but a 750-pound wheel, yet for mine car wheels, 16 inches in diameter, it gives excellent satisfaction.

It is not a case of secret mixtures, but the problem involves close adjustments to conditions of any convenient and suitable composition by means of a few or many kinds of scrap and steel and the smallest amounts of alloys and pig iron. Since 1888 I have closely calculated every mixture and have proven that within the usual and unusual limits for each element contained in both good and bad compositions, that only on a metallographic basis can these compositions be satisfactorily determined. Years ago I learned that there was no advantage in using expensive material, except when it increases the output at a lower cost than a mixture of cheaper first cost.

Test Bar Fractures

In Fig. 1 are shown the fractures of four test bars, which further will prove my contentions. The bar *A* was made of a mixture containing 99 per cent scrap and 1 per cent alloys and cost $10.48 per ton; *B* contains 99 3-10 per cent scrap and cost $9.80 per ton; *C* contains 91.2 per cent scrap and costs $8.43 per ton; *D* contains 91.3 per cent scrap and costs $13.01 per ton. While all of these mixtures are satisfactory for 4½-inch crusher jaws, nevertheless mixture *A* is the best adapted for this work.

Interesting fractures of chilled iron are shown in Fig. 3. In this view, *1* shows the chill of the tread and flange of a mine car wheel; *2* is the chilled test piece of metal for mine wheels, the bar being 1⅛ inches in diameter; *3* is the chilled part of a chilled test piece of mine wheel metal; *4* shows a fracture of an especially hard iron made in 1892 and *5* shows the fracture of a test bar, both sides being chilled toward the center.

Fig. 2 shows a fracture of a test bar of a mixture made for a high chill and exceedingly strong iron. No pig iron was used in this mixture, which contained different grades of scrap and steel. The alloy addition consisted of 0.2 per cent of ferro-titanium which contained 12 per cent of titanium. This addition was made in the cupola. This bar was 11 inches long and has been reduced one-half.

FIG. 8—MICRO-PHOTOGRAPH OF METAL ⅜ INCH BELOW SURFACE

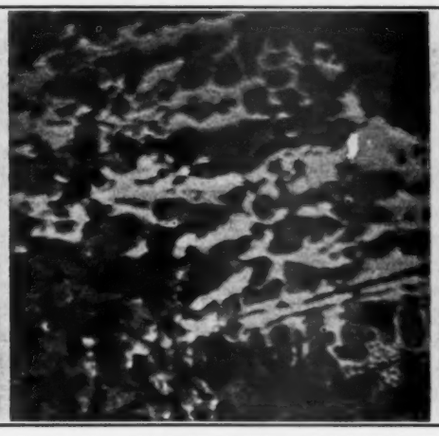


FIG. 9—MICRO-PHOTOGRAPH, SHOWING GRAPHITE, WHICH WEAKENS THE CHILL

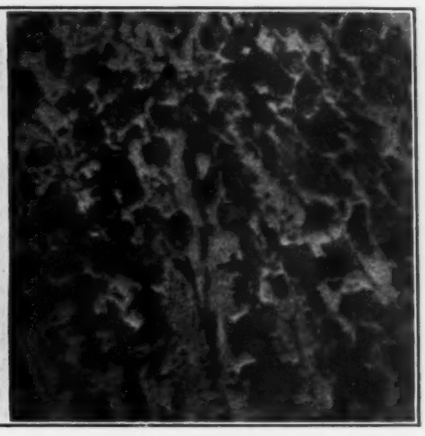


FIG. 10—MICRO-PHOTOGRAPH, SHOWING PEARLITE AND CEMENTITE, BUT NO GRAPHITE

Fig. 5 is a micro-photograph of a section of mixture *B*, previously referred to, which was cooled more slowly than Fig. 4. This shows the junction of large masses of large pearlite grains partly separated by ferrite and graphite.

In Fig. 6 is shown a micro-photograph of the hardest iron I have yet made, which contains 57 per cent cementite and 43 per cent of pearlite.

Fig. 7 shows 3 inches of perfect chill in a crusher jaw, 14¼ x 4 inches cross-section.

Fig. 8 is a micro-photograph of the metal ⅜ inch below the surface of a chilled test piece for 630-pound wheels. This test piece was not annealed. It

will be noted that it contains practically no graphite and only a slight amount of manganese sulphide in the pearlite.

Fig. 9 is a micro-photograph magnified 149 diameters, which shows the metal 7-16 inch below the tread of a 660-pound, 33-inch wheel, which failed in the tread and flange after a life of 10,000 miles. The darkest spots are the graphite which reduced the strength of the chill. Pearlite and cementite also are shown.

Fig. 10 is a micro-photograph 5/8 inch below the surface of a 24-inch wheel, made without charcoal iron or ladle dosing. The wheel was annealed in 42 hours. The chill in this wheel varied from 1¼ to 1½ inches. It will be noted that no graphite spots can be seen and, therefore, the chill was not weakened in this way.

Estimating the Price of Castings

AT THE monthly meeting of the Chicago Foundrymen's Club, held at the Great Northern hotel, Chicago, Saturday evening, March 16, A. O. Backert, editor of THE FOUNDRY, discussed the making of estimates for castings. He directed attention to the fact that estimating has proved a stumbling block in the foundry industry and to a large extent is accountable for the wide variations in prices frequently quoted on work by different foundrymen. Continuing Mr. Backert spoke as follows:

"While it is true that many foundrymen can approximately fix a price which will cover the cost of manufacture, nevertheless, with the large majority, it is merely guesswork and the foundryman hopes, that by hook or crook, he can make a profit on the job. In most industries the estimating department is one of the most important adjuncts of the business. Upon the estimator depends the success, not only of obtaining work, but of obtaining this work at a profit. In most foundries, however, the estimator is an unknown quantity and an estimating department can only be found in a few plants.

Unusual Method of Making Estimates

"What is the usual method of procedure when a foundryman is presented with a blue-print of a casting upon which a price is to be named? He invariably looks over the print in a casual way, guesses at the weight and then names a price. If he is informed that the price is too high and that his neighbor across the street has offered to do the work at 25 cents less per 100 pounds, he is not at all adverse to shading his price 50 cents, content in his ability to produce the work at a lower cost than his competitor.

"We have had co-operation in the foundry industry for many years, but we have never had the co-operation which will lead to dividends. Attempts have been made to organize price associations, but as all efforts aimed at the elimination of competition are founded on an unsound basis, these efforts invariably have failed. It is not necessary to control prices to make a profit on your work, but it is necessary to know how to estimate intelligently to establish a price which is certain to net a profit.

"It has been the experience of buyers of castings to obtain prices so widely varying that they have hesitated to place the business with the low bidder, while the highest price received has led them to conclude that some big error has been made in computing the cost of the work. It is not unusual on light work for prices to vary as much as 5 cents per pound. This indicates a lack of knowledge among certain foundrymen of how to properly make estimates."

Estimating School

The organization of an estimating school for foundrymen, foremen, superintendents and other foundry employes was recommended. The problems to be considered would consist largely of making estimates on job work, and figuring selling prices from blue-prints could be taken up when the students have reached a more advanced stage, while the preliminary training might consist of making estimates from the actual patterns. The following formula, which contains every factor that must be considered for making estimates, was presented: W + L + O + C + P equals the selling price. The cost of the metal in the ladle multiplied by W gives the cost of the metal in the casting; L represents all direct labor, such as molding and coremaking; O is the overhead expense, which includes direct labor and other charges; contingencies are represented by C, and includes casting losses, special rigging, etc.; P represents the profit, which in every shop should be a constant, applied alike to both light and heavy work.

To intelligently apply this formula the foundryman must know how to compute the weight of a casting, not only from a pattern, but from a blueprint of the work. He also must be able to approximate his labor cost, while overhead charges only can be obtained from a cost system which will take into consideration all charges that cannot be directly apportioned. Contingencies will require foresight on the part of the estimator and a wide factor of safety must be allowed to provide for possible losses. In conclusion, Mr. Backert said that in conjunction with the estimating school simple methods of cost-keeping can be taught and ultimately a uniform system can be outlined which can be applied, with few modifications, to practically every branch of the foundry industry, regardless of the size of the plant and the number of men employed.

After the meeting a buffet lunch was served in the main dining room of the Great Northern hotel.

A New Parting Compound

A parting compound adapted for molds for gray iron, brass, bronze and aluminum castings is manufactured by the Billings-Brown Co., Union Bank building, Cleveland. This compound is waterproof and will not interfere with the sponging of the mold. To test the waterproof properties of this parting material, molds have been closed five or six hours and were parted as easily as when opened immediately after compound had been dusted on the sand. This parting material, furthermore, will not affect the color of brass or bronze and as it is exceedingly fine, it is particularly well adapted for all bronze work. The compound, also, will not roll ahead of the metal.

Chicago Fire Brick Co.

The Chicago Fire Brick Co., with offices in the Chamber of Commerce building, Chicago, is now handling a complete line of foundry supplies in addition to fire brick for cupolas, furnaces, etc., which it manufactures. This company maintains five retail yards in Chicago and is equipped to make prompt shipment of orders of any size. G. A. Andresen has been placed in charge of the foundry supply and equipment department. F. W. Horrobin, for many years associated with the Waterbury Crucible Co., is now connected with the Chicago Fire Brick Co.

Mixing and Melting Iron Scientifically*

Why Iron Should be Mixed by Analysis Rather Than by Grade with a Brief Discussion of Semi-Steel

By David McLain

I AM not a chemist nor a specialist of any kind, but originally was a molder and have filled every position from twisting hay rope for core barrels to foundry manager. It is utterly impossible for me to talk to you on the subjects of mixing and melting without taking you back to my early days in the foundry. While employed in a crucible steel foundry in which coke furnaces or so-called *coke holes* were used for melting purposes I could not help but notice the difference in the steel produced when different melters were in charge of the furnace. For weeks there was scarcely a complaint about blow-holes in castings, but at other times it seemed as if we were unable to make castings free from these defects. The same grades of material were used, but for some unknown reason it became a fixed habit for the metal to go wrong at intervals. As the steel casting industry was in its infancy in this country at that time, this variation in product was considered one of the mysteries connected with the making of steel castings.

Variations in Melting Results

We had one 30-pot furnace, but as the business increased a 24-pot regenerative furnace was installed and for a time the coke holes were operated only when necessary. All were aware that the new furnace was a decided improvement over the old type, but using the same percentages of the same material in both furnaces, a larger percentage of good castings was obtained from the metal made in the coke holes, which were in charge of a melter of wide experience.

Later another regenerative furnace was installed and the coke holes were abandoned except when a large casting was poured requiring more metal than could be melted in the regenerative furnaces. This did not happen very often, although I remember casting a number of gears which required 76 pots of metal to pour each one. The point I want to impress is, that regardless of the style of furnace used, if the melter is not thorough, blow-holes will occur in the castings, irrespective of the material charged in pots.

The regenerative furnaces were superior to the coke holes, but the mode of operation was entirely different. Operating the coke holes, the melter could try the metal frequently, and if he found a cold pot, he could give it more attention than was possible in the other type of furnace. Considering average results, better metal was obtained from the regenerative furnaces than from the coke holes, which were abandoned.

Bessemer Converter

As the company was desirous of making larger castings, it was decided to install a Bessemer converter. An addition was built to the plant and a large jib crane, cupola and converter were installed and Bessemer steel castings were made. This was the first foundry in the country to use Bessemer metal for steel castings exclusively.

The Bessemer process did not appear to be a success for castings at the beginning and as the converter had a capacity of 7 tons it was not convenient to pour small work. There were many *cold blows* and very little attention was given to the melting of the metal in the cupola. Sometimes the metal from the cupola would be cold. Again, it would be held in the cupola ladle much longer than usual before being charged into the converter and the result would be a cold blow.

Later I had charge of this Bessemer plant, which enabled me to begin, at an early age, to put some of my theories into practice. For economical and other reasons our company decided to install an open-hearth furnace of 20-ton capacity, which necessitated the rebuilding of the entire plant and the dismantling of the Bessemer outfit. A very good melter was brought from the east and a few heats of this metal demonstrated that it was the ideal metal for steel castings. Subsequently there was a change of melters, and while the new melter claimed he was the *greatest ever* our losses reached high proportions. Finally a good melter was secured and at once the casting losses were reduced.

Later I was placed in charge of a small crucible steel plant which had been a failure under the management of a very capable iron founder, and the officials were amazed to learn that I did not require different grades of material from that used by my predecessor. Imagine their surprise when they learned that good castings, free from blow-holes, were being made from the materials used by the former superintendent, simply because good melting was being practiced.

A few years later when arranging a plant to make gray iron and steel castings, my superior had neglected to state he wanted to make non-ferrous castings until it was too late to install a brass foundry department. Hearing of his desire, I at once told him we would melt brass in the crucible steel furnace, but as he was pretty well posted on non-ferrous metals he claimed brass foundrymen would not use oil for melting purposes. (This was 14 years ago.) I wondered why, but as I had no brass foundry experience, I determined to seek advice from men who knew all about it, but was told not to use oil, as it would spoil the metal. This must sound like a joke to those who are melting brass with oil today, although many still use coke.

Steel Crucibles Used for Brass

We made tons of high grade, non-ferrous castings but were treated to a surprise while doing so. Our steel crucibles were often in fairly good condition after being abandoned for melting steel and I believed they could be used for a few heats of brass. These old steel pots gave us an average of 11 heats in brass, many running 16 heats, which led me to try a new steel pot for brass exclusively. This pot had a life of 52 heats. The brass mixtures were melted in the steel furnace after the last pot of steel was pulled and the oil shut-off, for quite often the temperature of the furnace was so high no extra oil was used to melt the metal, but the general practice was to use oil. How was it possible to

*Presented before the Pittsburgh Foundrymen's Association.

use these crude furnaces for this purpose? *Good melting.*

How is it possible for one man to make high grade castings using the *same* percentage of the *same* brands of iron, using the same quality of fuel, while a man in charge of another shop using identically the same grade of material will make poor castings? Again, *good melting.*

How is it possible for one foundryman to use 30 to 50 per cent of steel scrap while others can only use 10 per cent? To answer this question a more definite explanation is required than merely to answer—good melting. It really requires scientific melting.

Scientific Melting

To get the best results from the cupola, the details must be well arranged. The proper amount of air must be delivered through blast pipes proportioned to offer the least resistance; tuyeres should be provided to permit the air to enter cupola in volume; the material should be charged intelligently and the size of the charge should be determined by the size of cupola.

The coke should be high in carbon, which means low ash, and it must be low in sulphur. Much good, high carbon coke is being made today, but when purchasing you should specify the carbon and sulphur content. Then, when the coke is still on track, samples should be sent to a commercial chemist in order to learn whether you have been shipped coke up to specification. There is no excuse whatever for the use of poor coke, because if you know good coke and specify what you want, the coke companies will supply it. Mistakes in shipments will happen, of course, but an analysis of each car of coke will prevent mistakes eventually.

One of my eastern clients received a car of poor coke and stated that the iron came hard and dirty. His company did not want to have it analyzed as it was a well-known brand. Finally an analysis was made and it was found to contain 33 per cent ash and volatile matter.

Even though you have to pay more money to get the best coke, pay it, because less coke is required to melt the iron. When you learn that some foundrymen are melting 15 pounds of iron with 1 pound of coke between charges and that not less than 12 pounds of iron should be melted with 1 pound of coke between charges, you will then realize that scientific melting means more to the foundry than you have ever given it credit for. Whether making crucible, converter or open-hearth steel, cupola or air furnace iron, or non-ferrous metals, good melting is the keystone to success.

A large majority of gray iron foundrymen have never given cupola practice the consideration it deserves, but they manage to pull through. Few men in charge of converter plants pay attention to the cupola, because they do not realize the importance of satisfactorily melting the iron in this furnace.

It has been proven that the best castings are made in shops employing a man who can mix irons by analysis. But to mix irons by analysis means more than being able to figure a charge or heat when the percentage of elements in the material is known. The man who is responsible for the mixtures must know just what proportion of the various elements should be in such charge for light or heavy and different classes of castings. The successful mixer must have a chemist's report on each car of pig and coke and he must order pig iron containing the elements most suitable for his castings.

Mixing by Analysis

The experienced mixer knows that good melting enables him to carry a lower silicon in his mixtures, which invariably means stronger castings. He will have little use for silvery or high silicon pig. He knows that his cupola is not a blast furnace, therefore, he will have no use for limestone for short heats. He also uses steel in the mixtures to make stronger castings.

If he has castings to make of unequal section which are subjected to hydraulic or other tests, he will not make mixtures high in silicon, sulphur, or phosphorus, because of the danger of segregation. I don't claim that you will not lose any castings when mixing by analysis, but I do claim that every mold that has been properly made, closed and clamped securely should produce a good casting. Now I want to ask a fair question. If molds are made right, closed, clamped and poured carefully, why should castings be lost?

When it is known that it will only require 15 to 20 minutes to figure the different mixtures for separate charges to cover the day's heat, then the claim cannot be made that it takes up too much time to do this work. The highest priced pig is not always the best for all grades of castings nor is the cheapest pig the best for certain castings, but many foundrymen work along these lines.

Eighty to ninety cents of every dollar spent in the foundry has been expended before melting begins and you can either make a profit or loss by mixing and melting the material scientifically or by guess work.

The firm by which I was employed as foundry superintendent built a foundry to make iron, steel and brass castings, having previously purchased its castings from jobbing shops. This practice proved unsatisfactory, as the castings consisted of parts for air brake equipment used on street cars. The records of the machine shop proved that the loss on small cylinder head castings ran as high as 60 per cent. Investigation proved there were also large losses on this cylinder head casting in every foundry in which the pattern was placed. At that time the pattern was in a Detroit foundry, and as their losses were only about 50 per cent, our machine shop superintendent advised that we allow the pattern to remain there. The pattern, however, was called in and my troubles began. In a short time the loss was reduced to 35 per cent, and, as a plan had been devised to test the castings before machining, the company was pleased with the showing. A loss of 35 per cent on iron castings, when I had been able to make steel castings with a loss of 2 per cent and under, was very discouraging. Foundry friends all advised a change in the pattern, but our manager would not listen to it, as he claimed when the metal was right, castings were right, and later developments proved that he was correct.

Manganese

The writer devoted much study to the use of steel and the effect of manganese on the mixtures, but referring to text-books, the following information was obtained:

Manganese increases the saturation point of iron for carbon.

Manganese will remove sulphur if used in the ladle.

Manganese is a hardening element above 0.85 per cent.

Manganese is no good when used in the cupola, because the temperature is not high enough to melt it.

Manganese converts graphitic carbon to combined carbon.

With all this expert opinion against me, I felt at times as if it were better to leave steel alone, but several inconsistencies in the above statements left me a loop-hole to work on. The statement that manganese converts graphitic carbon to combined carbon appeared all right, if there was no silicon in the mixture, but as silicon converts combined carbon to graphitic carbon, what would happen if both manganese and silicon were fairly high?

All textbooks state that steel is used to reduce carbon, but how are you going to make soft castings of light sec-

tion if the total carbon is low? It was apparent that if manganese increased the "saturation point of iron for carbon," it was necessary to use it, because if carbon is low, light sections will be hard, but as silicon must be low for close-grained metal, probably a low silicon, high carbon metal would solve the problem, and it did.

Increase of Carbon

When figuring the estimated analysis of the material in a charge entering the cupola, the total carbon was found to be only 2 per cent. Regardless of the silicon content of the castings, they would be hard if the total carbon was only 2 per cent. However, when metal was poured and analyzed, it was found that the carbon had increased to 3.58 per cent and these light castings were soft, although the silicon was low.

The steel and manganese did exactly what they were calculated to do. The total carbon was increased, thereby reducing the sulphur and allowing the lower silicon mixture to be used. The result was a close-grained metal, free from segregation and blow-holes.

In 1903 a full description of my method of using steel and manganese in the cupola was sent to one of our leading metallurgists, and the following extract from his letter is quoted to give you further confidence in semi-steel:

"You have hit on a point which bears out all my years of contention on the oxidation of iron in the melting process. Where you use such high percentage of steel, you necesarily have a higher temperature in the melt, and with this higher temperature any addition of manganese means a reaction with the oxygen present from the unavoidable burning of the steel in the charges. In ordinary cast iron this cannot take place, as the temperature is not high enough, hence manganese is not a good thing there. I presume that you must lose quite a lot of manganese by this process, which shows that it is effective and does the work it is put in for."

Cupola Capacities

In making investigation of iron melting practice I have demonstrated that any cupola could be arranged to melt 10 pounds per hour per square inch of cupola area when the proper amount of coke is used. I have compiled the following table of cupola capacities from the data which I have gathered:

Inside diameter of cupola, inches.	Melting capacity, tons per hour
30	3½
36	5
42	6½
48	9
54	11
60	14
66	17
72	20

You will find cupolas melting faster than this, but in every instance we have demonstrated that it is a mistake to melt at a greater capacity, unless on very long heats.

Semi-steel is made in the same cupola with regular mixtures. It is far superior to the ordinary metal made from gray iron in either cupola or air furnace and for strength, homogeneity, durability, and fine wearing qualities it has no superior. Sponginess or segregation cannot exist in semi-steel.

In making metal for high grade castings, steel and other scrap, together with the pig is placed on the bed, making as many charges for semi-steel as desired. This is followed with the usual mixtures. If metal for dies, anvil blocks or castings of a similar character are desired, semi-steel may be melted during the latter part of the heat.

No more coke is necessary to melt steel mixtures than gray iron, but it is advisable to use a heavier split of coke between the last charge of semi-steel and the following charge to prevent the latter from melting through. Contrary to advice offered by experts, the steel melts quicker than the pig iron.

Steel scrap should never be melted in the ladle, but should be charged in the cupola, as a high temperature is necessary to melt steel properly.

Steel borings and turnings may be used to advantage, which are charged in the same manner as for gray iron. All kinds of material, such as steel foundry scrap, gates, risers, boiler clippings, punchings, shearings, structural material, angles, I-beams, ties, channels, rails, railroad scrap and wrought iron may be used. From 10 to 30 per cent of steel may be used in mixtures for castings of light sections and 30 to 50 per cent of steel scrap may be used in castings of heavy sections. I have many clients using 45 per cent of steel in heavy gas engine cylinders.

Generally, melting conditions are favorable when melting steel, but this is not true when melting iron in the cupola. The high carbon, silicon, sulphur and phosphorus in iron mixtures melted with coke produce more gases and impurities than when melting steel, and I claim a higher percentage of manganese should be used to free the iron of those impurities. However, when the cupola is not melting up to capacity, the necessary temperature to cause perfect combustion is insufficient. The claims made by eminent authorities that there must be a vast difference in the same brands of pig iron may easily be exploded, not by some mysterious laboratory experiment, but by scientific melting and mixing of iron. An intelligent foreman or superintendent is the logical selection as the mixer of iron, because he is in close touch with the particular line of work you handle.

Segregation and Shot in Iron*

By E L Rhead

THE segregation and concentration of the constituents of cast iron have an important bearing on the properties of the metal. If segregation did not occur, the use of cast iron for the purposes for which it is now employed would be impossible. The complex nature of the material is well-known and the names and percentages of its constituents have become familiar to foundrymen, although it is doubtful whether the true meaning of the quantities are always understood. Thus, 1 per cent of silicon suggests that out of every 100 parts, one consists of silicon, and 0.5 per cent of phosphorus suggests that in every 200 parts, one part will be phosphorus.

To illustrate this point, a cubic foot of fairly dense iron weighs about 450 pounds, and if the constituents are carbon, 3 per cent; silicon, 2 per cent; phosphorus, 1 per cent; manganese, 0.5 per cent, and sulphur, 0.15 per cent, the actual weights would be 13 pounds, 8 ounces of carbon; 9 pounds of silicon; 4 pounds, 8 ounces of phosphorus; 2 pounds, 4 ounces of manganese, and 10¾ ounces of sulphur, or a total of 29 pounds, 14¾ ounces. Of these various constituents, carbon is the only one that occurs in the metal in the free state. The others and even some of the carbon are chemically combined. Silicon, phosphorus and sulphur combine with both the iron and the manganese. This combination produces new substances having properties quite distinct from the original elements.

Thus, carbon produces carbide of iron in which the carbon only forms 6.676 per cent of the whole. Silicon forms a silicide in which the silicon is only 33.3 per cent of the compound. Phosphorus forms two phosphides of iron, one of which contains 15.5 per cent of phosphorus and the other 31.1 per cent of phosphorus. Sulphur forms a sulphide which contains 36.3 per cent of sulphur; hence, 1 per cent of combined carbon rep-

*Abstract of a paper presented before the Lancashire Branch of the British Foundrymen's Association.

resents 15 per cent of carbide; 1 per cent of silicon, 3 per cent of silicide; 1 per cent of phosphorus, 15 per cent of phosphide and 0.1 per cent of sulphur produces nearly 0.3 per cent of the sulphide. Generally speaking, about 5 to 7.5 per cent of silicide, 12 to 14 per cent of carbide and 15 per cent of phosphides may be present in an ordinary casting. The balance is iron and graphite.

Physical Properties

The physical properties of metal containing these constituents will, therefore, depend upon the manner in which they are mixed with each other and with the remainder of the iron, both while molten and after cooling. If they are completely soluble, no separation will occur and the metal will possess a uniform structure. When one body dissolves another it is known as a solvent and the mixture is a solution. When the solution is saturated, it has dissolved as much of the solution as it can hold under the existing conditions. This point may be arrived at in two ways, either by adding the dissolving body until no more is taken up, or by altering the conditions, so that under the new conditions the solution is saturated. A supersaturated solution is one which, under the existing conditions, contains more of the dissolved body than it is capable of permanently retaining. Such a condition often results from slow cooling without disturbance. The excess separates when the solution is agitated or when crystallization commences.

The amount of a substance that can be taken up by a solvent will depend upon various considerations. It increases with the temperature and may increase or diminish in the presence of other bodies. In a melted mass, the solubility of the constituents is further influenced by the temperature of their solidification. The withdrawal of some of the constituents from the mass as the temperature falls, will influence the solubility of the remainder, and the degree of concentration that is attained. The complex nature of cast iron causes the changes to be very complicated, and the raising or lowering of the mean melting point would be dependent upon all the constituents. As the metal cools, these constituents begin to separate in the order of their refractoriness, and the withdrawal of each from the main mass accelerates the separation of the others, either separately or as a compound, leaving at each successive step a fused residue that is being constantly depleted. The greater the range of temperature over which this occurs, the greater will be the degree of separation possible.

Separated bodies are of two classes, namely those that separate from a saturated solution, and those that are left fluid or are rejected in the solidification of a mass. The first class comprises bodies of high melting point and low solubility, and the second class may be divided into two bodies, those that are left fluid and those that separate after solidification. When cast iron is perfectly melted, all the carbon present is in solution. This solubility depends upon the temperature and the presence or absence of other bodies. Metal in the ladle often contains less carbon than the original pig iron, due to the latter having been produced and saturated with carbon at a higher temperature than is attained in melting. Frequently, when held in the ladle, the molten metal throws up kish as a scum, showing that the graphite is separating, and being comparatively light, it rises to the surface. This shows that the metal contains more carbon than is suitable for making strong castings. In such a case the metal will continue to part with carbon even when in the mold, and the carbon will keep rising while the metal is fluid, and will collect at the highest point of the casting. After solidification, the remaining carbon will separate in the usual manner, and the size of the flakes of graphite will depend upon the rate of cooling.

Carbon Concentration

When the metal is not saturated at the pouring temperature it may enter and fill the mold completely without any separation taking place, but as it cools, the saturation point is passed and a deposit of carbon commences, producing a nuclei on which further deposits take place as the temperature falls and the saturation limit is lowered. This action continues as long as the iron is sufficiently hot to permit of free movement, and produces coarse graphite. Carbon concentration occurs in the vicinity of the graphite flakes, and as the freedom of movement becomes more restricted. the carbon particles cannot be transmitted so readily and new centers of deposition result, producing finer graphite. This continues until cooling is completed. When the saturation limit is not reached until the metal has cooled considerably, and the freedom of movement of the particles is restricted, coarse graphite does not form.

If at any stage the action is arrested by cooling, the condition of the constituents remains as it was at the temperature at which it was arrested. Slow cooling, therefore, permits the most perfect separation. Certain bodies, such as silicon, promote the decomposition of the carbide and lower the saturation limit, thus promoting the formation of graphite. Irons yielding kish are usually high in silicon. The action of silicon in promoting decomposition of the carbide and segregation of the graphite is shown by the absence of graphite from white iron, which is always low in silicon. The formation of graphite flakes divides up the casting into areas in which the silicon and the remainder of the carbon are present. As the cooling proceeds, the carbide separates, yielding a pearlitic structure. Phosphide of iron is the most fusible constituent of iron, and, consequently, lowers the melting point of solutions into which it enters, to a greater extent than any other substance. It is completely dissolved by the iron when the metal is molten. Iron free from carbon will retain iron phosphide in solution up to 1.7 per cent phosphorus. It is not soluble in the carbide on cooling, and as the carbon contents increase, the phosphide separates as the metal cools. It is not completely separated by as much as 3.5 per cent of carbon.

Silicides retard the separation of phosphorus and a large amount may be retained in solution until some of the graphite has been separated. As the temperature falls, the excess of phosphide forms, with the other fluid portions, a liquid having a low melting point. This liquid continues to deposit some of the constituents of higher melting temperatures, as the temperature falls, and becoming enriched in phosphorus, remains molten until the final solidification, when it frequently spreads into the form of network, the continuity of which will depend upon the amount of phosphorus, the composition of the metal and the rate of cooling. If the network is continuous, the casting will be dominated by the phosphide and will be hard, being weak when hot and brittle when cold. The latter quality unfits such castings for purposes where strength is required, or where jarring and vibration are encountered. In strong, close-grained castings, where the silicon content is kept low to insure strength, the phosphorus must also be low. In some cases where great strength is necessary the maximum amount of phosphorus should not exceed 0.2 to 0.3 per cent.

The relative behavior of carbon, silicon and phosphorus will explain some of the vagaries observable in

Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Note—This sheet may be cut into two sections, 5 x 7 inches, and may be readily bound in note-book form.

METHODS OF FINDING THE AREA OF IRREGULAR FIGURES.

By W. L. Tryon

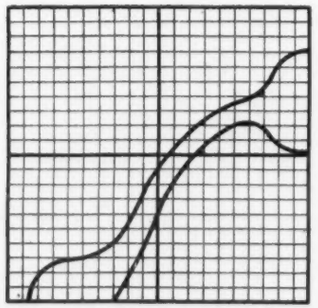


FIG 1

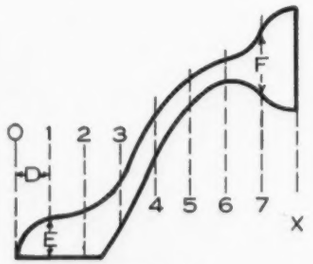


FIG 2

To find the area of an irregular figure, use one of the following methods:

Cross-Section Paper, Fig. 1

Draw the figure on cross-section paper. Count the number of whole squares and estimate the number of fractional parts of squares, and add the sum of all the fractional parts of squares to the number of whole squares. The area of the figure is the product of this sum multiplied by the area of one square. Thus, if cross-section paper ruled to tenths of an inch is used, the area will equal the sum of whole and fractional parts of squares multiplied by 0.01, that is, $(0.1)^2$.

Simpson's Rule, Fig. 2

Divide the length of the figure into an even number of parts of equal length, *D*, by parallel lines, called ordinates; add the lengths of the first and last ordinates included in the boundary, calling the sum *A*, that is E + F = A. (Note—*O* and *X*, which do not cross the figure, are not counted.) Then add the lengths between the boundaries of the even ordinates (2, 4, 6), and designate it the sum *B*, and then the odd ordinates except the first and last calling this sum *C*. Then the area of

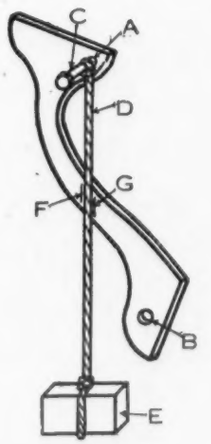
$$\text{the figure} = \frac{A + 4B + 2C}{3} \times D$$

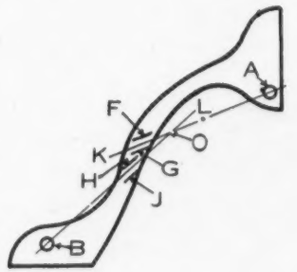
Note.—The greater the number of division, the greater accuracy is obtained.

Data Sheet No. 111, The Foundry, April, 1912.

METHOD OF FINDING THE CENTER OF GRAVITY OF IRREGULAR FIGURES.

By W. L. Tryon





To find the center of gravity of any irregular figure, first lay out the figure on stiff paper, then cut it out and punch two holes, *A* and *B*, the diameter of which should be larger than that of the pin, *C*, then hang the body on the pin, *C*, at *A*, so that it can move freely. Then attach a cord, *D*, with a weight, *E*, to *C*, in such a manner that they can also move freely. When the body, cord and weight have come to rest, mark on the body the lines, *F* and *G*, along the sides of the cord. Then in the same manner, suspending the body at *B*, obtain the lines, *H* and *J*, laying down the body on a piece of paper draw *A-K*, passing midway between *F* and *G*. Then draw *B-L*, and then the intersection of *A-K* and *B-L*, that is *O*, which is the center of gravity required.

Data Sheet No. 112, The Foundry, April, 1912.

different samples of cast iron in which the phosphorus contents, as shown by the analyses, are the same. In some cases shot is produced. These particles occasionally are found in cells they do not completely fill, or are found loose in cavities in the casting. In the case of some loose shot taken from a large cavity at the end of a lathe bed, the castings had the following analysis: Silicon, 1.9 per cent; phosphorus, 1.5 per cent, and sulphur, 0.11 per cent. The composition of the shot was silicon, 2.4 per cent; phosphorus, 4.33 per cent, and sulphur, 0.44 per cent. In another case the composition of the iron was silicon, 2.56 per cent; phosphorus, 1.9 per cent; carbon, 3.5 per cent, and manganese, 0.6 per cent. Shot obtained from the castings made of this metal contained silicon, 0.8 per cent; phosphorus, 4.06 per cent; carbon, 1.24 per cent and manganese, 0.6 per cent. Shot found in castings results from the separation of the phosphide while the iron is sufficiently fluid to permit of its contraction to a globular form. As specific gravity of the shot is practically the same as that of the remainder of the metal, it will not rise to the surface with the other impurities. In all cases where shot has been observed by the author, the iron has been highly carbonized and not especially high in silicon. The extrusion of shot into cavities results from the contraction of the already solidified portion of the casting squeezing the still liquid eutectic into the cavities. In the case of the tool bed mentioned, the hole in which the shot was found was a shrink hole of considerable proportions, near the end from which the casting had been run. It was caused by the abstraction of the metal to feed the casting. This end of the casting had remained hot for the greatest period, because all the metal had passed this point. For very thin castings, it is the universal practice to use high phosphorus iron to obtain fluid metal for sharp castings. If the metal cools in running over the surface of the mold it follows that the least fusible portions will be first abstracted, leaving a more highly phosphoric fusible metal to go forward. This would result in the portion of the casting farthest from the runner being more phosphoric and in consequence, harder. If two streams of metal meet while such a mold is being filled, they may amalgamate perfectly, owing to the greater fluidity produced by the phosphorus, but are likely to result in a hard spot in the castings across the junction of the two streams.

The Recovery of Iron From Foundry Refuse

By W J Keep

MORE than ordinary interest is manifested in the recovery of iron from cupola slag and so many inquiries are being received on this subject that a few suggestions might prove of benefit to many foundrymen. It is customary to pick large pieces of iron and coke out of the slag and naturally some of the slag is thrown away which contains some iron, although it has never been proposed to break up all the slag and to treat it for the recovery of the metal it contains. A large amount of iron can be recovered from the sweepings from the gangway. This metal usually consists of shot iron dropped by the molders while carrying their iron to their floors. Furthermore, considerable iron collects around the heads and gates of molds which is thrown into the gangway. The other iron to be recovered is that which is dropped with the cupola bottom and is too small to be picked out by hand. If it were practicable, considerable iron could be saved by breaking up the cupola slag.

I will first describe the method pursued in our foundry. When the heat is off, and while the tuyeres are being cleared of slag, the floor in front of the cupola is cleaned and a circular ridge, about 4 feet in diameter and 5 inches high is made with damp sand. Next we ram-in the breast of the cupola with a piece of old shafting about 8 feet long, which can be rested on one of the tapping bars placed across the spout. When the breast is broken away the iron and slag will flow freely into the cleared space in front of the cupola. The slag will rise to the surface of the pool and the iron will sink to the foundry floor. It frequently becomes necessary to stir the slag in the cupola to keep it running. When the cupola is clean the bottom is dropped. The following morning the slag is removed from the floor and a slab of iron will be found underneath. The slag, which was tapped the previous day is then broken and the iron is removed. The sand bottom is taken out and is examined for iron and thrown away with the slag. The remainder of the dump is picked over and unmelted iron, coke, etc., are recovered. Very little iron will be found to remain in the dump and very little slag will have to be broken-up when this method is used.

Customary Practice of Iron Recovery

The customary practice in many shops is to permit the iron to run out of the spout as long as it will flow after the blast is shut off. However, a large amount of iron is mixed with the slag in the cupola and as a result the dump the next morning will be hard to break and large pieces of slag which seem to contain no iron are thrown away. The difference between our method and the ordinary method is that we separate the slag from the melted iron by gravity while it is in the molten condition, although many foundrymen break up this mixture after it has cooled and then endeavor to recover the iron. As a result, a large amount of iron is lost and more labor is required to recover the metal. The next problem consists of separating the iron from the fine material in the dump. Our method is to shovel everything into boxes whose contents are discharged into the cupola after the last charge of iron. This material is shoveled into boxes, no fork being used to eliminate the fine material. More than one-half of this fine material consists of coke and there is considerable slag, which, when melted, will flow out of the breast. The coke aids in melting the slag and iron and in this way practically all fine coke and all fine particles of iron are recovered. We place the skulls of ladles and all screenings from the gangways in this last charge in the cupola.

Next the cinder mill method will be discussed. The fine coke and iron from the dump are charged in the cinder mill, which contains a few pigs of iron to break up the slag and cinder. The iron and shot are recovered in the mill while the finer material passes through the slots between the cast iron staves. The iron saved is usually charged into the cupola with each charge of iron. When using a water mill the fine material from the dump is shoveled into the mill, which

is water-tight, and as it revolves an inside crusher breaks the cinder. This mill is so constructed that all broken coke and slag rises to the surface of the water and passes off through a trunnion into a wheelbarrow. When the mill is opened the iron will be found in the bottom, but the fine coke has been washed away.

In our shop the gangways are regularly swept and the sand and iron is shoveled into boxes and the contents are discharged onto an oblique screen in the yard. The sand is riddled through this screen while the iron passes from the screen into a box. However, as the screen is rather coarse some fine shot is necessarily lost. Frequently this screening is done in the gangway by hand with a much finer riddle than we use and a larger amount of the fine shot is saved.

When using a magnetic separator the fine material from the dump is supposed to be broken up so that all the iron will be separated and the sweepings from the mashway are run over a rather coarse, oblique screen which is oscillated by the machine and the finest shot falls through this screen. In passing over the magnetized cylinder all of the iron adheres to it while the slag and dirt are carried off.

All of the methods generally followed provide for screening the gangway sweepings while the loose shot is generally lost. In many cases large pieces of the sand bottom and slag which seem to be free from iron are thrown away. The heaviest loss is sustained as a result of this carelessness. It is essential that great care be exercised in recovering iron from slag, sweepings, etc., as great economies in metal consumption can be affected by attention to details.

Molding Gas Engine Pistons

By E B Horne

PISTONS for automobile gas engines are cast in both dry and green sand molds, although experience has taught that the latter method is the most satisfactory. For making these molds, molding machines of the stripping plate and roll-over types are used to advantage. Two pistons are cast in one mold and a wall of not more than 3 inches of sand should be left between the two piston molds. The method of gating is an important feature in the production of satisfactory piston castings. In Fig. 2 is illustrated a good method of gating, but the bearing surface for the core is small, thereby increasing the danger of crushing. In Fig. 3 a method of gating is shown which was adopted for the purpose of overcoming sponginess and the cracking of the upper rim. In Fig. 4, it will be noted that the gate of the piston at *B* is contracted and is smaller than the area of the gate where it enters the mold. This is done to obtain clean iron and the contraction at *B* has a tendency to retard the flow of the iron which effects a separation of the slag from the iron. Furthermore, the runner is located entirely in the cope, which assists greatly in preventing the slag from flowing into the mold with the metal.

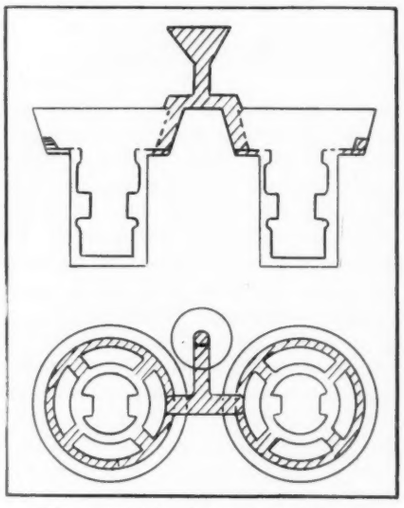


FIG. 2—ANOTHER METHOD OF GATING

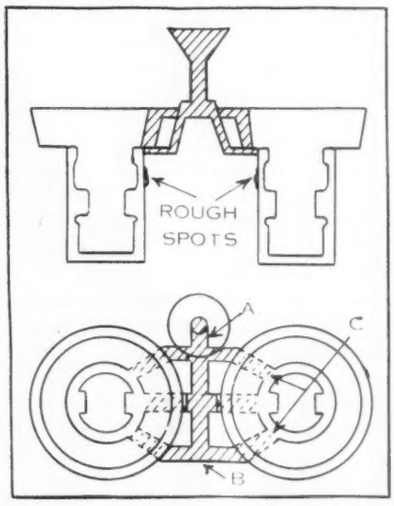


FIG. 1—IMPROPER METHOD OF GATING A MOLD FOR PISTONS

Sand Holes in Pistons

Frequently, pistons are found to contain small sand holes not larger than 1-64-inch in diameter. These spots result in the rejection of the casting, as gasoline will almost invariably leak through the piston at these points. Pistons frequently exhibit these defects and one reason for this is an improperly constructed gate. A gate of this type is shown in Fig. 1, which is contracted at the points *B* and *C*, and the gate is smaller in area than at *A*. The iron, therefore, will be carried into the mold under pressure and will cut the core carrying grains of sand to the bottom of the mold. If the casting develops rough spots about an inch below the gate, it is a certain indication that further defects will develop after machining. Using a gate as shown in Fig. 4, the metal is retarded in its flow beyond points, *B*, and will only lightly impinge upon the core. To further diminish the possibility of cutting, a small amount of coarsely bolted seacoal should be added to the sand. Brushing dry graphite at and around the gate and the piston is also advantageous.

To reduce the amount of facing sand used in piston molds, a sheet iron pipe is set over the pattern, clearing it ½ inch throughout its entire circumference. The facing sand is filled into the intervening space and the remainder of the

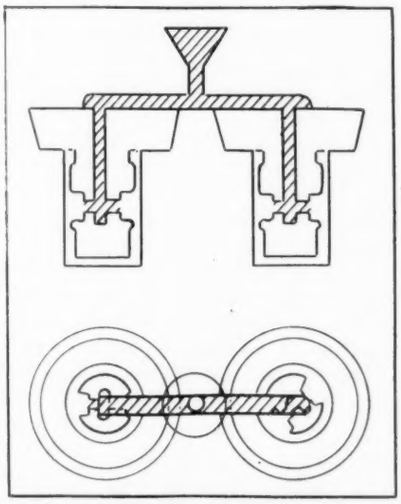


FIG. 3—METHOD OF GATING TO OVERCOME SPONGINESS

sand is filled into the flask outside of the pipe. The pipe is then withdrawn and the ramming of the mold is commenced. This method provides a layer of facing sand, ½ inch thick, around the entire circumference of the piston pattern.

Spongy Pistons

Sponginess is frequently developed as a result of improperly designed pistons which carry heavy bosses for the piston pins and grooves for the piston rings. Shrinkage is counteracted by placing chills at points where difficulties have been previously experienced. The chills are coated with graphite and kerosene, turpentine mixed with red lead, or shellac. The thickness of the chills used is of great importance as the rapid setting of the metal only is desired and a chilling effect on the

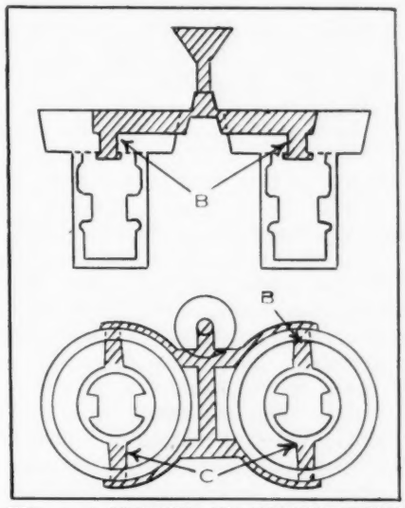


FIG. 4—A METHOD OF GATING WHICH WILL INSURE GOOD RESULTS

iron which will harden the casting at these points should be avoided. Frequently the coring-out of the bosses is resorted to so as to overcome shrinkage. This, however, increases the difficulties of machining as the tool in drilling will follow the cored hole and if it is cored out off center, trouble is sure to follow.

Analyses of iron which will insure good wearing pistons follow:

No. 1.—Total carbon, 2.80 per cent; graphitic carbon, 2.30 per cent; combined carbon, 0.50 per cent; manganese, 0.40 per cent; phosphorus, 0.20 per cent; sulphur, 0.10 per cent, and silicon, 2.50 per cent.

No. 2.—Total carbon, 3.20 per cent; graphitic carbon, 2.90 per cent; combined carbon, 0.30 per cent; manganese, 0.40 per cent; phosphorus, 0.30 per cent; sulphur, 0.08 per cent, and silicon, 2.75 per cent.

If a smooth casting that will machine easily is desired, mixture No. 2 is recommended. In selecting the pig iron for this work the physical structure is a factor which should be considered as carefully as the chemical analysis. This is confirmed by observations of foundrymen who have found that a certain mixture, made by analysis only used from day to day, will not always insure uniform results.

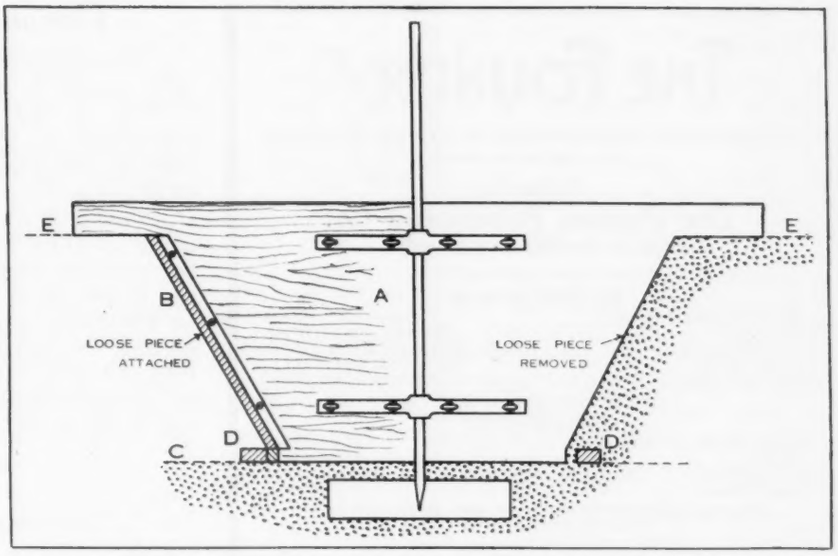


FIG. 1—SWEEP FOR MOLDING A CIRCULAR BED PLATE

Sweep-Molding a Circular Bed Plate

By John Eastham

The method of molding an iron bed plate, which will be described herewith, may serve to show the undoubted utility of the sweep or strickle for molding circular castings of complicated design, particularly if economy in pattern-making is essential. A single bed plate casting was required which was tapered, as shown in Figs. 1 and 2, four lugs being cast onto the large or base end with a flange extending entirely around the small or upper end of the casting. As it seemed probable that a casting of this size and shape might not be required again, a sweep, *A*, Fig. 1, was made, to which was attached loose piece, *B*, to facilitate sweeping the inside and outside faces of the mold.

A bed was leveled at the full depth of the casting required, as indicated at *C*. At *D*, the sections of the flange pattern were laid in position, facing sand was rammed over and behind these pieces and gaggers were laid in position every few inches to protect the overhanging mold when drawing these pieces inwardly. The loose piece, *B*, was then removed from the sweep and the mold was swept to the inside size as far as the parting line, *E*. The sweep was then removed and the full area of the inside of the mold was lined with wet parting

(Continued on page 170.)

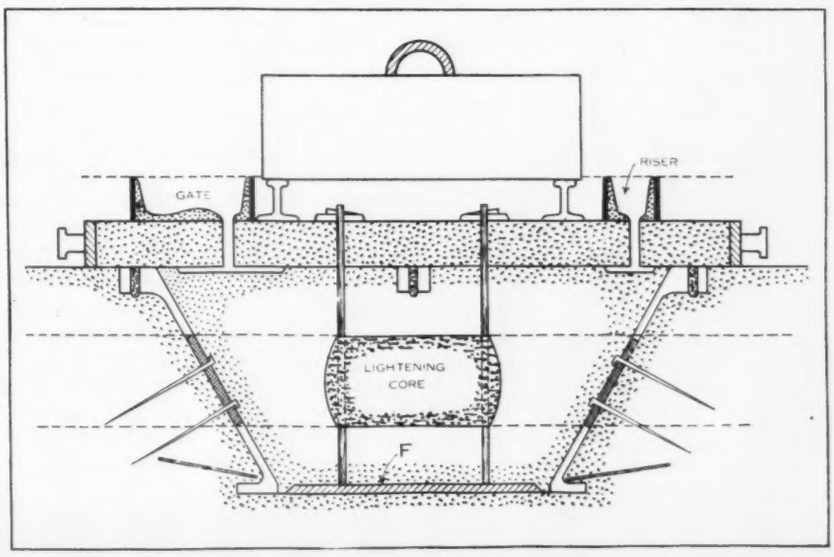


FIG. 2—CROSS-SECTION OF THE BED PLATE MOLD

THE FOUNDRY

A monthly journal devoted to all branches of the foundry business.

Published by

The Penton Publishing Co.

Penton Building, CLEVELAND

BRANCH OFFICES

BIRMINGHAM, ENG. - - - - Prince's Chambers
CHICAGO - - - - - - 1328 Monadnock Block
CINCINNATI - - - - 503 Mercantile Library Bldg.
NEW YORK - - - - - 1115 West Street Bldg.
PITTSBURGH - - - - - - 2148-49 Oliver Bldg.

SUBSCRIPTION

United States and Mexico - - - - - - $1.00 a year
Canada - - - - - - - - - $1.50 a year
Great Britain and other Foreign Countries - Eight Shillings
Single Copies - - - - - - - - 15 cents

Copies published three months or more previous to date of current issue, 25 cents each.

ADVERTISING

All communications relating to advertising copy, discontinuances, etc., must be received on the 10th of the month preceding date of publication.

COPIES PRINTED

This Issue - - - - - - - 11,000

Entered at the Postoffice at Cleveland as Second Class Matter.

Copyright, 1912, by the Penton Publishing Co.

Contents

What Should a Cost System Accomplish 127
Mottled Malleable Iron 132
Spongy Iron Difficulties 132
Should Risers on Molds be Covered 133
Galvanizing Small Sheet Steel Products 134
Foreign Molding Machine Installations 134
Emergency Jobs With Inexpensive Rigging 135
Duplex Copper Baths 137
Troubles of the Electroplater 138
Use of Green Sand Cores in Aluminum Work 141
Crucible Lifting Device 146
A German Crucible Furnace 146
Results of Manganese Bronze Experiments 147
Brass Foundry Difficulties 148
A Jacketed Foundry Ladle 150
A Practical Pattern Storage System 151
How to Avoid Pin Holes in Iron Castings 152
American Institute of Metals 152
Foundry Ladles 152
Control of Mixtures for Cast Iron Car Wheels 153
Estimating the Price of Castings 156
A New Parting Compound 156
Mixing and Melting Iron Scientifically 157
Segregation of Shot in Iron Castings 159
The Recovery of Iron From Foundry Refuse 161
Molding Gas Engine Pistons 162
Sweep-Molding a Circular Bed Plate 163
Demand for Skilled Molders 164
Horrors of the Drop Bottom 164
Estimating Prices on Castings 164
Trade Outlook 165
The Passing Throng 165
Reviews of the Latest Books for Foundrymen 166
Combination Molding Machine 167
A Light Capacity Crane 168
A New Core Machine 169
Mechanical Electroplaters 169
The Foundrymen's Convention 170
Personal 171
A Quick-Detachable Grab Bucket 171
General Industrial 172

Demand for Skilled Molders

A WORLD-WIDE demand for skilled molders seems to exist and a report from Germany is to the effect that wages for high-grade mechanics are steadily advancing. Inability to secure desirable apprentices is assigned as the cause of this scarcity and many ambitious boys turn away from the grime of the casting shop, evidently measuring-up their future opportunities in the foundry by outward appearances. The constantly increasing employment of the molding machine also must be attributed with its share of responsibility in depleting the ranks of the skilled molders, as the men engaged in the operation of these labor-saving tools, to a large extent, are specialists and have no training in either floor or bench work.

Horrors of the Drop Bottom

AT A RECENT meeting of a British foundrymen's organization, all of the horrors of the drop bottom cupola were described in detail by one of its members. He said that the cupola tender is always working "with the awful possibility in view of the bottom coming out or the metal coming through the edges and that sort of thing". He also pointed out that over Sunday the furnace becomes very cold. This, he stated, necessitated an entirely new green bottom and until this is heated the furnace cannot be worked. Reports of foundry accidents in the United States fail to record the dangers of the drop bottom, nor does the metal find its way through the edges around the doors, as has been intimated, and an occurrence of this kind would lead to the employment of another and more capable cupola man. The difficulties of a cold furnace and a new green sand bottom have not been half expressed. The old shell cools off every day and to facilitate the operation the lining is only too frequently cooled-down with a stream of water. This practice may reflect the American foundryman's disdain for the melting pot, but the truth has not yet been told. A new green sand bottom is rammed into the cupola every morning and hot iron a few hours thereafter not only is expected, but is demanded. If our British friends—and they are legion—would give the drop bottom furnace a trial they would never return to the solid bottom type.

Estimating Prices for Castings

DID you ever meet a foundryman who would not give you a price on a casting from a blue-print without hesitation? Never. The number of foundrymen who make careful estimates on a job, taking into consideration all possible cost factors can be counted. This is rather a broad statement, but it's true, nevertheless. Is the average foundryman so skilled in his chosen vocation that he can fix a price on a casting off-hand, or is it merely guesswork and dependence on averaging of prices throughout the year that enables him to continue this practice? It is a sad commentary on the foundry trade that estimates are given so little consideration. True, some shops employ skilled estimators and it is a rare occurrence that a

job is taken that will not net a profit. Too much is at stake to permit the practice of guessing at the selling price of castings to continue, and in every foundry, regardless of its size, some employe should be equipped to estimate on work intelligently. Many variable factors must be considered which require great ingenuity to properly estimate, while the constants, including the cost of metal, indirect labor and overhead, as well as the profit, should be carefully computed. Unfortunately, discussions of making estimates on the cost of castings have been religiously avoided at the meetings of the various foundrymen's organizations. The reason is apparent, yet the subject is of vital interest to those engaged in the operation of plants for the production of castings. Estimating schools should be conducted by every local association of foundrymen for the benefit of those engaged in the sale of castings. The course should include instructions in computing the weight of castings from the blue-print, figuring the cost of molding and coremaking as well as estimating contingencies which include casting losses, cost of rigging and other expenses not usually considered when making an estimate on a job. That the prices of castings will advance sharply in all centers where such schools are established is a foregone conclusion and foundrymen then will be assured fair profits for their work and on their investment.

Trade Outlook

THE growing consumption of pig iron and nonferrous metals reflects the increased melt in the foundry trade and while many shops are not operating up to capacity, nevertheless specialty plants and others engaged in automobile work are unable to make prompt deliveries. Prices for castings, unfortunately, remain at low level and quotations on steel and gray iron sections, particularly in large foundry centers, barely cover the cost of manufacture. That the molding expense is being carefully investigated by many foundrymen is indicated by the continued heavy sales of molding machines for all classes of work, and that the makers of these tools are keeping pace with the requirements of the trade, is indicated by the large number of new designs which are being placed on the market. In the steel trade there is no abatement of the activity which developed during the closing months of last year and the more generous buying policy of the railroads has resulted in an increased tonnage for the malleable and steel foundries. One of the noteworthy developments of the iron trade is the announcement in the reduction of prices on iron ore, varying from 65 to 75 cents a ton at lower lake ports. This decline in the cost of ore, however, will have no immediate effect on pig iron quotations as all of the blast furnaces are smelting high-priced raw material and the ore purchased on the new schedule will not be received by furnace operators until midsummer. To a large extent this reduction has been discounted and ruling pig iron quotations are at so low a level that this decline will scarcely disturb existing values. In the leading centers No. 2 foundry iron is quoted as follows: New York, $14.50 to $14.75; Philadelphia, No. 2X, $14.75 to $15.25; Pittsburgh, $14.15; Cleveland, $13.25; Chicago, local, $14; Cincinnati, northern, $14.70, and Birmingham, $10.25. Quotations on other grades of foundry iron follow: Malleable Bessemer — Chicago, $14, and Pittsburgh, 13.90; basic—Pittsburgh, $13.90, and Philadelphia, $14.25. Foundry coke continues to advance and standard Connellsville is held at $2.75 to $3 at the ovens for prompt shipment, and $2.40 to $2.60 for forward delivery.

The Passing Throng

DURING the last ten years the evolution in foundry practice has been wonderful and of equal interest have been the kaleidoscopic changes in the human element which cannot be disassociated from the record of the forward strides in the art of casting metals. The skeptic who was positive that molds could not be made on machines because they lacked the *molder's touch* so essential in ramming has been forgotten for many a day. The evidence was so overwhelmingly against him that he begrudgingly admitted, finally, that there possibly might be something in these new-fangled devices. His companion was the *doubting Thomas* who had to be shown that it was unnecessary to vent a jar-rammed mold, but he has never been convinced that there is not a secret passage somewhere for the escape of the steam and the gas. Next we recall the cupola specialist who dealt in secret powders and lotions guaranteed to alleviate the aches and pains of any ailing melting pot. He was a picturesque character, too, and his exit was deplored if for no other reason than that he cast a hypnotic spell over the entire shop by his presence. The antidote for spongy iron was always administered into the gaping maw of the furnace with due ceremony and the contents of the concoction was a carefully-guarded secret which was handed down from one generation to another. We will next introduce the cupola tender who based his prediction of hard or soft and hot or dull iron on prevailing weather conditions. The air of mystery with which he surrounded his work inspired an awesome feeling in the remainder of the employes and his frequent change of base was terrorizing to the foundry manager. His first cousins are still with us, but fortunately in reduced numbers. They still persist in making mixtures by brands and grades, regardless of the elements in the iron. The chemist, a comparatively new aspirant for honors on the foundry stage, has scored heavily and his repeated successes have insured him a contract containing a clause for an unlimited period of employment. The metallurgist also has forced his way into the ranks and has won favor by revealing the mysteries of the cupola specialist. He diagnosed the ailments of iron before it reached the casting stage and his palliatives, to a limited extent, are the commercialized products so skillfully sold and harmfully applied by the cupola quack. While reviewing the passing throng, the melters of steel and malleable iron must not be overlooked. Failure or success depended solely upon their skill in selecting materials, but the underlying principles of their operations were never revealed to others—or to them—until scientifically explained. The ranks of foundrymen, depleted by those who labored in the dark, are rapidly being filled again by another generation headed toward the light and carrying a banner imprinted with the slogan which made Missouri famous.

Reviews of the Latest Books for Foundrymen

The Casting of Iron and Non-Ferrous Metals; by Hugo Wachenfeld; 103 5½ x 8½-inch pages; illustrated; published by Wilhelm Knapp, Halle, Germany, and furnished by THE FOUNDRY for $1.50 postpaid.

This work is devoted largely to German brass foundry practice and contains chapters on the making of molds, melting problems and numerous mixtures. A section of the work also is devoted to iron foundry practice, shop equipment and arrangement. This work is in German.

Engineering as a Vocation; by Ernest McCullough; 201 5¼ x 8-inch pages; published by the David Williams Co., New York, and furnished by THE FOUNDRY for $1, postpaid.

The subject matter of this work has been rearranged with additions from a number of addresses given before technical schools and associations by the author. It is published primarily for the information of parents that they may act wisely in selecting a career for their sons. The work and education of the engineer are discussed and home study courses are outlined. Pertinent suggestions are also made with reference to "Hunting and holding a job," and the problem of whether it pays to study engineering is also discussed. The work concludes with the opinions of a number of engineering editors on engineering as a profession.

Iron and Steel Foundry Practice; by C. Geiger; Vol. 1; 472 7¼ x 10½-inch pages; illustrated; published by Julius Springer, Berlin, Germany.

This German work will be issued in three volumes and while exceedingly comprehensive, as indicated by the first volume recently published, the practice considered is that largely prevalent in German foundries. Various subjects discussed have been contributed by foundrymen and engineers who have specialized in the various branches of the founder's art considered. The chapter on the history of the iron and steel foundry industry was written by Ludwig Beck, while the chapter on iron ore was contributed by Dr. E. Trescher. Among the subjects discussed in the first volume are ferro-alloys, scrap, chemistry of the iron and steel foundry, physical properties of cast iron, fuels, temperature measurements, iron and steel foundry refractories and mixtures for iron, steel and brass foundry practice. The second volume will deal largely of molding and melting practice and the third volume will be devoted to the arrangement, equipment and management of foundries.

Physical Tests and Chemical Analyses of Iron and Steel; by O. Bauer and E. Deiss; 258 6½ x 9½-inch pages; published by Julius Springer, Berlin, Germany, and furnished by THE FOUNDRY for $2.25, postpaid.

This German work is divided into two sections, the first being devoted to tests of iron and steel, written by O. Bauer, and the second section, by E. Deiss, discusses chemical determinations of iron and steel. Considerable space is devoted to metallography and methods of obtaining and testing bars for gray iron, pig iron, malleable and steel determinations are included. Methods of making chemical analyses also are clearly outlined, and the work throughout is exceedingly comprehensive.

Foundry Practice, by R. H. Palmer; 332 5¼ x 8-inch pages; illustrated; published by John Wiley & Sons, New York, and furnished by THE FOUNDRY, Cleveland, for $2, postpaid.

The author is a practical foundryman of wide experience and while engaged as an instructor in foundry practice at the Worcester Polytechnic Institute, Worcester, Mass., he was handicapped by the lack of a suitable textbook, and the method of instruction he followed is presented in this volume. From the simplest type of mold, the students and apprentices are gradually led to the more difficult lines of work in green and dry sand and loam. From the many possible examples which might have been used to illustrate the different practices, only those have been selected which are typical of the various classes of work. In the preface the author states that he has endeavored to make a textbook for the student, apprentice and molder rather than a reference work for the trained foundryman, and the work indicates how well he has succeeded.

Elementary foundry work is discussed in the opening chapter and from simple floor work the author, in logical sequence, carries the reader to the more complicated molding operations, such as the use of sweeps, bedding-in patterns, etc. Chapters are also devoted to making molds for steel castings, dry sand cores, methods of gating and arranging risers, shrinkheads and feeding heads; the treatment of castings while cooling, cleaning castings, molding machine work, etc. The various methods of repairing broken castings are likewise briefly discussed and include burning, thermit and oxy-acetylene welding. Cupola practice and the making of mixtures are discussed at length and many valuable suggestions are made which are based on the practice of the author. A glossary of foundry terms is also included, which is exceedingly comprehensive and the appendix contains numerous valuable tables, analyses, mixtures, etc. As a textbook on foundry work this volume should prove of great value to students, apprentices and molders.

Second Supplement to the Directory to the Iron and Steel Works of the United States; 80 5½ x 8½-inch pages; published by the American Iron and Steel Association, Philadelphia, and furnished by THE FOUNDRY for $5, postpaid.

This supplement, and its predecessor in 1910, brings down to the close of 1911 all essential details concerning the new iron and steel plants which have been completed or undertaken since the publication of the directory in 1908. It includes also, important changes that have since taken place in the ownership and equipment of plants that have previously been described. Appreciating the need by the iron trade of a complete list of the blast furnaces of the United States that were in existence or were under construction at the end of 1911, whether built or undertaken since the appearance of the directory of 1908 or previously, a complete list of these plants has been compiled and is presented in this directory. A new department also has been added which is devoted to the electrical and ferro-alloy plants identified with the iron trade or which are largely dependent upon it. James M. Swank, general manager of the American Iron & Steel Association, announces that it will be impossible to compile and publish another edition of the directory in 1912.

Equipment for the Foundry and Pattern Shop

Combination Molding Machine—Plain Power Squeezer—Light Capacity Crane—New Core Machine—Mechanical Electroplater—A Quick-Detachable Grab Bucket

A COMBINATION jar - ramming and squeezer molding machine and a plain power squeezer have been added to the line of molding equipment, built by the U. S. Molding Machine Co., Cleveland. The combination machine rams the mold without hand labor as the squeezing operation, accomplished by power, eliminates the necessity of butting-off the mold by hand after jar-ramming. As shown in Figs. 1, 2 and 3, this machine is equipped with a guide or small cylinder, 5 inches in diameter and 8 inches long, for jar-ramming the mold and the 12-inch cylinder, to which air is admitted after the mold is rammed, is provided for the squeezing operation. While the flask is being filled with sand, air is admitted to the small cylinder and the mold is jar-rammed. After adjusting the bottom-board, the cross-arm carrying the pressing head is swung into position over the flask, it is automatically latched and air is admitted to the large cylinder for squeezing the mold. The frame of the machine to which the cylinder is bolted is L-shaped and to relieve the frame from vibration when jar-ramming, the cylinder is supported at the bottom by two heavy studs.

Contacting Surface

The contacting surface of the piston and cylinder flanges is of large area, which insures a uniform distribution of the blow and also reduces to the minimum the possible crystallization of the metal in these castings. The guide casing is attached to the cylinder with studs and the guide is similarly attached to the piston. The table is attached to the piston with countersunk screws and can readily be removed and replaced by a large table if desired. The back frame of the machine forms the support for the swinging cross-arm to which the pressing head is attached. The cross-arm revolves around a heavy shaft in the top of the frame and the pressing head is attached to a 2-inch screw provided with a heavy lock nut which permits of the rapid adjustment of the head for any depth of flask. This feature enables the operator to set the head so that it will just clear the bottom-board and the distance of piston travel for the squeezing operation is thereby greatly reduced and will rarely exceed 1 inch. By this arrangement the air consumption is economized.

To the free end of the cross-arm is attached an adjustable rod provided with a latch which engages with a lug on front of the cylinder when the mold is being squeezed. This machine is equipped with a knee valve for actuating the vibrator and a blow-off cock and has a capacity for ramming molds up to 12 inches in depth, regardless

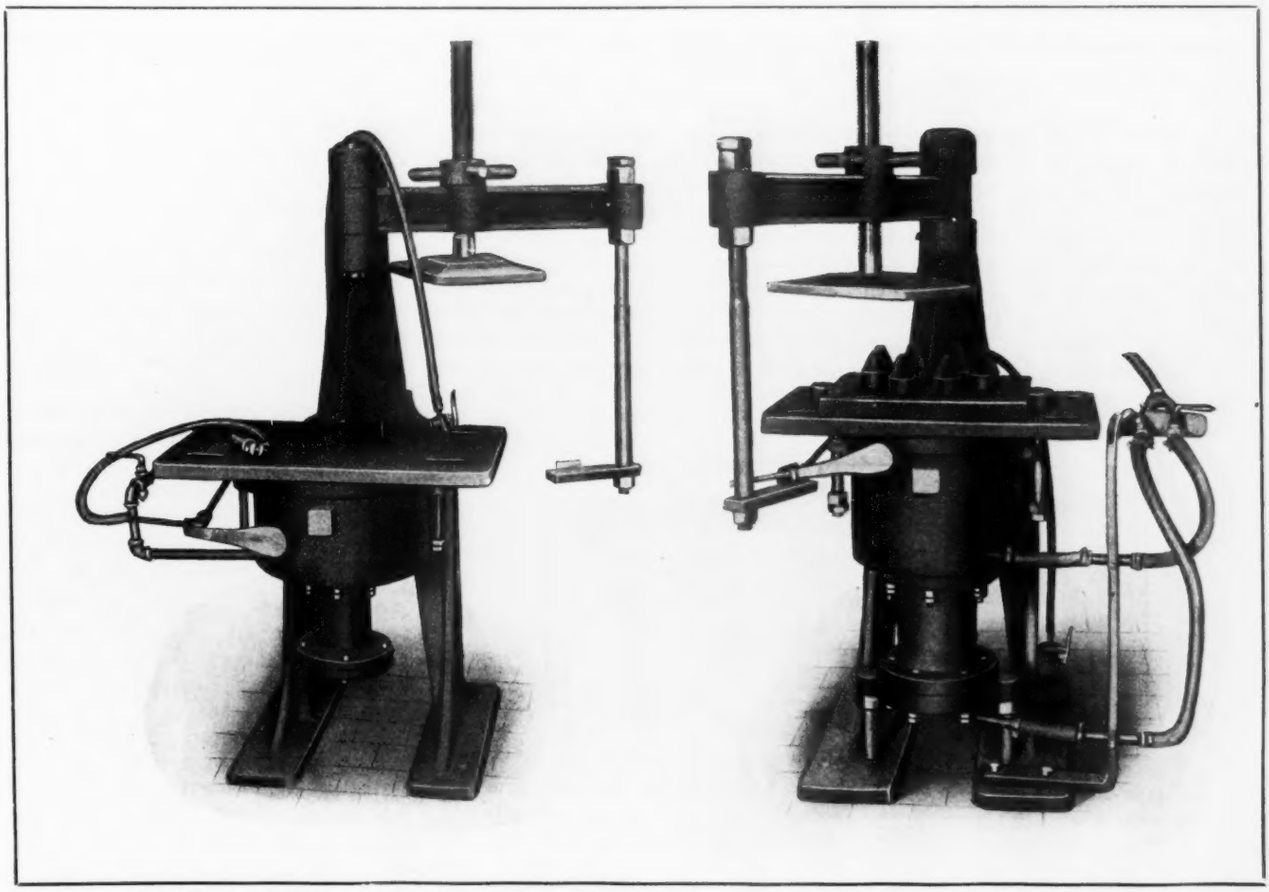


FIG. 1—COMBINATION JAR-RAMMING AND SQUEEZING MOLDING MACHINE

FIG. 2—PATTERN PLATE ON TABLE OF COMBINATION MOLDING MACHINE

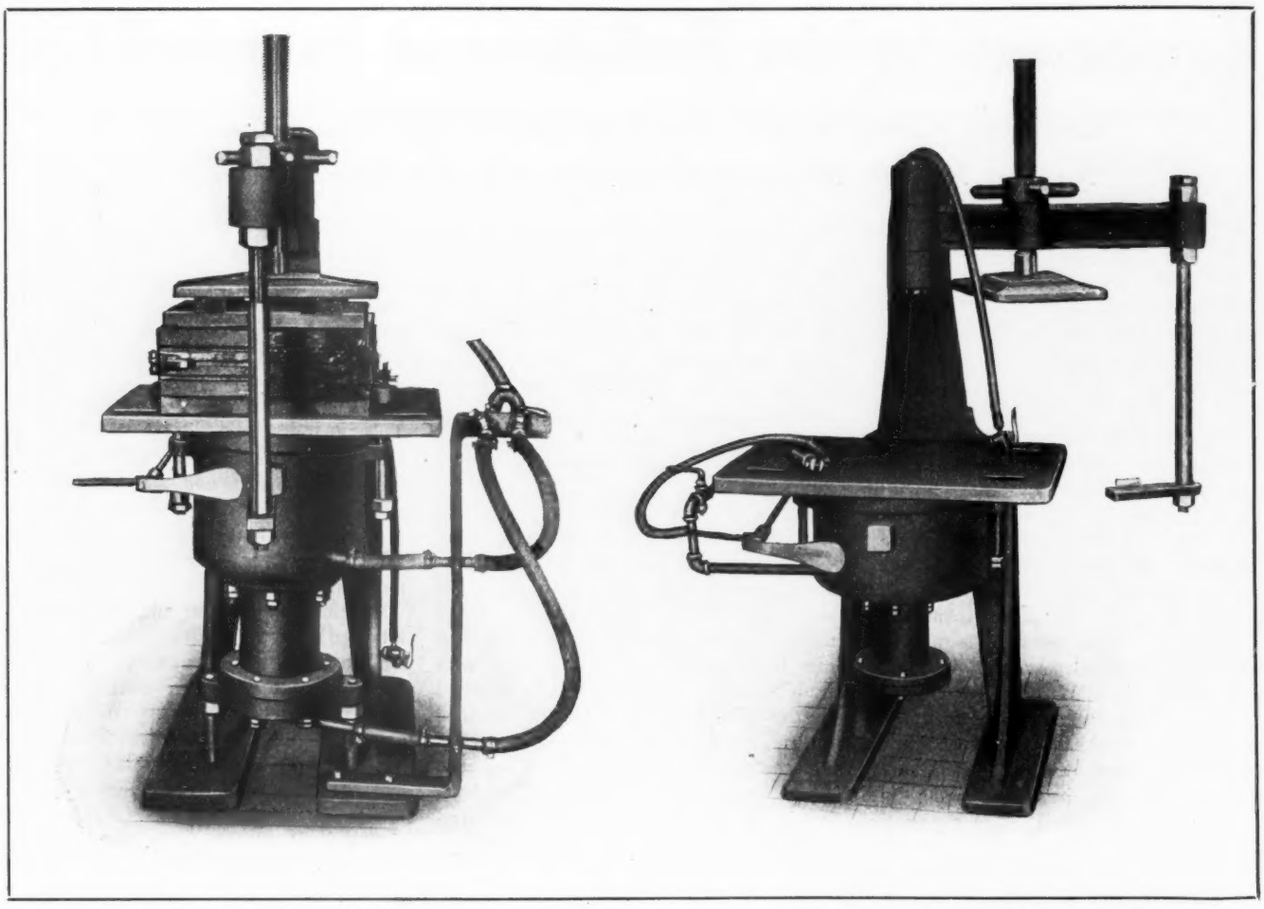
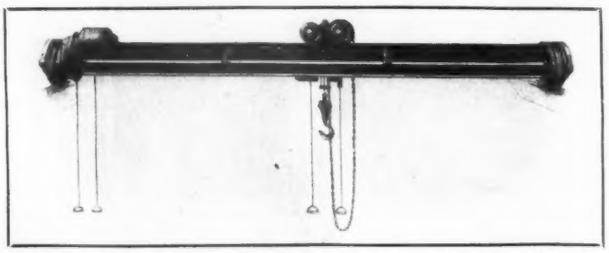


FIG. 3—COMBINATION MOLDING MACHINE IN SQUEEZING POSITION

FIG. 4—PLAIN POWER SQUEEZER

of the form of the pattern or the amount of draft. The table is 18 x 26 inches and will accommodate flasks of this size. While four slots have been provided, one in each corner of the table for attaching pattern plates or follow-boards, it is not necessary to fasten the pattern to the table, as it will remain in the position in which it is placed throughout the jar-ramming operation.

In Fig. 1, this combination machine is shown with the pressing head swung aside and without a pattern plate on the table. In Fig. 2, the pattern plate has been placed in position ready to receive the flask. The mold, in position for the squeezing operation, is shown in Fig. 3. The bottom-board has been adjusted on the snap flask, the cross-arm carrying the pressing head has been swung over and latched, and to finish the mold, air is admitted to the 12-inch cylinder for squeezing. Discharging the air from this cylinder releases the flask and presser head and when the cross-arm is unlatched it is swung back into the position illustrated in Figs. 1 and 2, and the mold is removed to the floor. This machine also can be used as a plain jar-rammer and when thus employed, the cross-arm and pressing head are swung aside. In the construction of this machine, the use of springs has been eliminated.

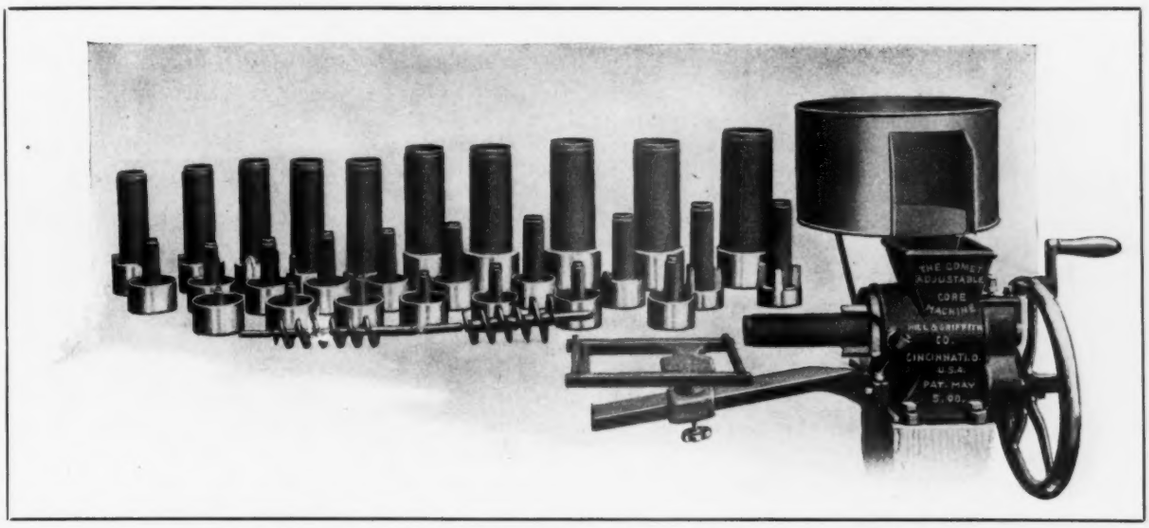


LIGHT CAPACITY TRAVELING CRANE, EQUIPPED WITH ELECTRIC HOIST

The plain power squeezer built by the U. S. Molding Machine Co. is illustrated in Fig. 4. In practically all essentials, this machine is similar to the combination jar-rammer and squeezer shown in Figs. 1, 2 and 3, with the exception that it is not equipped for jar-ramming. The guide of this plain squeezer is 3 inches in diameter instead of 5 inches on the combination machine. The supports for the cylinder to relieve the shock of the jar-ramming blow also have been eliminated. The cylinder to which air is admitted for squeezing the mold is 12 inches in diameter and the machine is equipped with a knee valve for the vibrator as well as a blow-off cock.

A Light Capacity Crane

A combined electric and hand-power crane of moderate capacity and limited speed has been designed by the Northern Engineering Works, Detroit. The crane is built in one, two and three-motor types and when motors are omitted a hand gear, operated by a pendent hand chain is substituted. For general use, the travel of the hoist and bridge is actuated by motors, although in some cases, especially when the cranes are of small capacity or short span, only a hoist motor is used. In that case



CORE MACHINE FOR MAKING CORES FROM ⅜ TO 4 INCHES IN DIAMETER

the travel of the crane is controlled by hand. As shown in the accompanying illustration, the crane bridge is of the double girder type with the trolley traveling on top of the girders. The hoist is suspended from the trolley between the bridge girders. When the crane is built for hand travel the axles are equipped with roller bearings lined in steel cages, but when designed for motor travel the bearings are bronze. Either direct or alternating current motors can be used.

The gearing of the hoist is enclosed and the hoist can be bolted or attached to the trolley in such a manner as to permit of its removal and its use in another part of the shop if desired. Wire rope is used for hoisting and all of the gears are of the cut type and are enclosed for internal lubrication. An automatic stop prevents the hook from running into the drop. Hoisting and lowering are accomplished by power and the load is automatically controlled and held in place by an automatic brake. This crane is made in capacities ranging from 1 to 6 tons and the spans vary from 10 to 40 feet to accommodate the width of the building in which the cranes are installed. These cranes are well adapted for yard work, for service in foundries, and for use in cleaning and shipping rooms, store houses, machine shops, etc. The accompanying illustration shows a two-motor crane with the hoist and bridge travel actuated by motors and the trolley travel controlled by hand.

Two high resistance alloys recently patented contain, copper, 60 per cent; manganese, 10 per cent; nickel, 30 per cent. Copper, 40 per cent; manganese, 40 per cent; and nickel, 20 per cent.

A New Core Machine

In the accompanying illustration is shown a core machine, built by the Hill & Griffith Co., Cincinnati, which has a capacity for making round cores from ⅜ to 4 inches in diameter. The machine is of the screw type and is entirely self-contained, including the sand hopper, and can be attached to a 6½ x 8-inch post by four screws. No tools are required for changing the dies for making cores of different size and it also is equipped with an adjusting device which enables the operator to make either hard or soft cores, as desired. Furthermore, this machine will make cores from mixtures containing a number of dry core binders now available, oil mixtures not being essential to the satisfactory operation of the machine. A device is also provided which brings into position immediately the core trays for any diameter or length of die that is used. This core tray support is shown attached to a bar at the front of the machine. This core-making device is built in two combinations, ⅜ to 3 inches and ⅜ to 4 inches, inclusive. The smaller machine can be arranged to make cores up to 4 inches in diameter if so desired. The dies and screw conveyors are semi-steel castings, the points of the screw conveyors being hardened to reduce wear.

Mechanical Electroplater

A mechanical electroplating machine, built by Frederic B. Stevens, Detroit, which is adapted for plating small articles, such as screws, bolts, nuts, rivets, washers and other products which are to be plated in large quantities, is illustrated in Figs. 1, 2 and 3. This machine can be furnished for plating nickel, brass, copper and also for galvanizing. The plater is so constructed that it can be adapted to any plating

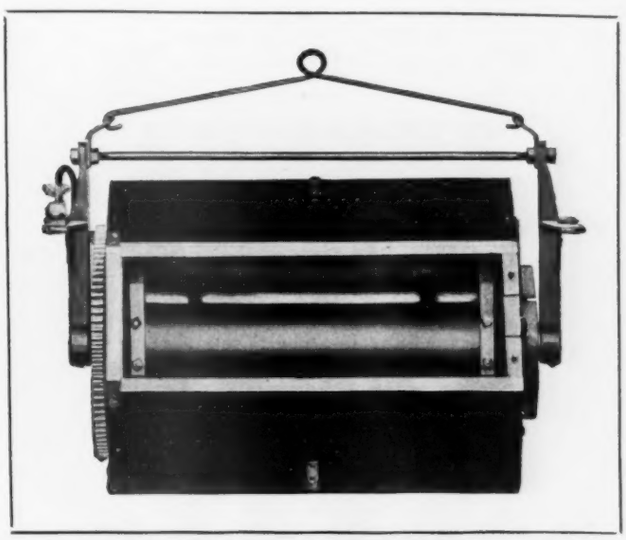


FIG. 1—MECHANICAL ELECTROPLATER, SHOWING THE BARREL OPEN WITH THE ANODE SUSPENDED ON A BAR ABOVE THE SHAFT

tank, 24 inches wide or over, and it is furnished with end cross pieces attached to the top of the tank which contain the driving mechanism and the electrical connections. The drive and connections are above the tank, thereby obviating the possibility of leaky tanks as is often the case when the driving mechanism extends through the side.

One of the novel features of the construction of this plater is that no anodes are required in the tank, a special anode being provided inside of the machine in close relation to the articles to be plated. As is well-known, the electroplating process consists of the deposition of metal from the anodes through the plating solution, onto the articles to be plated. In tanks in which the anodes are placed outside of the plating barrel, the metal to be deposited must pass through the perforations in the barrel to reach the work and as these perforations must necessarily be small, the process of depositing the metal is impeded and the time required for satisfactorily plating the articles is considerably increased. In this machine the anode is inside of the plating barrel close to the articles to be plated. The anode furnished with the plater weighs 45 pounds, whereas when the anodes are placed outside of the barrel, they weigh from 160 to 180 pounds. The inside dimensions of this plater are 18 inches in diameter and 24 inches long. The capacity depends upon the nature and shape of the work. It will plate from 75 to 100 pounds of small products, such as washers, rivets, burrs or screws, in from 40 to 50 minutes. The time required for unloading and refilling the machine is approximately 5 minutes.

A hoist is furnished with each plater for raising the barrel above the tank while the end cross bars remain attached to the top of the tank. When operating, the articles to be plated are placed in the barrel which is then lowered and rests on the cross pieces. The driving gears are next locked and the switch, on one end, and the commutator brush on the opposite end, are closed. The barrel should be revolved about five revolutions per minute. Electric current enters the machine at the driving end through the hollow shaft and is connected with the anode which is held stationary in the upper part of the barrel. The current then passes from the anode to the work in the lower half of the barrel and is carried out by the cathode wires, attached on the inside of the barrel, to a segmental commutator. It then passes through a brush back to the negative pole of the dynamo. In Fig. 1, the barrel is shown open and the anode is suspended from a bar above the shaft. Fig. 2 shows the driving gear end and positive connection, and Fig. 3 is a view of the commutator end and the negative connection.

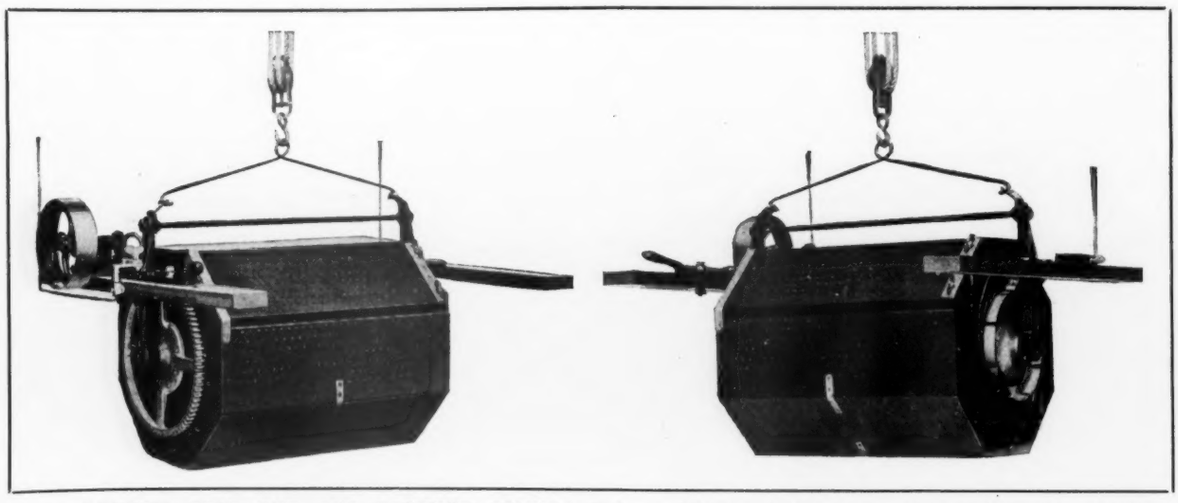


FIG. 2—DRIVING GEAR END AND POSITIVE CONNECTION OF MECHANICAL ELECTROPLATER

FIG. 3—COMMUTATOR END AND NEGATIVE CONNECTION OF MECHANICAL ELECTROPLATER

The Foundrymen's Convention

During the week of Sept. 23, the annual conventions of the various foundrymen's associations will be held in Buffalo. The exhibit which will be conducted by the Foundry and Machine Exhibition Co. will continue throughout the week, whereas the American Foundrymen's Association, American Brass Founders' Association and Associated Foundry Foremen will only be in session three days, namely, Tuesday, Wednesday and Thursday, Sept. 24, 25 and 26. The headquarters of the American Foundrymen's Association will be at the Hotel Statler. The local committee is now actively engaged in making preparations for this meeting, and from the interest manifested by foundrymen and exhibitors a large attendance is assured.

Sweep-Molding a Circular Bed Plate

(Continued from page 163.)

sand. A lifting plate, *F*, Fig. 2, was next rolled into position and the inside was rammed to the joint. The cope was then raised and the plate was wedged by lifting eyes cast into it for that purpose. The cope, supported by the lifting plate, was then raised from the mold, and as an almost perfect lift was obtained, the cope was lowered onto trestles and was finished underneath, any tendency to drop in turning over being thereby avoided.

The sweep was then placed in position with the loose or thickness piece, *B*, Fig. 1, screwed on and the mold was swept to the outside size of the casting. The four lugs, shown in the sectional view of the mold, Fig. 2, were afterward bedded-in and after withdrawing the lug patterns, the bolt hole cores were placed in position.

Four lightening or hand hole cores, extending the full thickness of the casting, were next placed in position at equal distances and were securely spiked, as shown, after which the loose sections of the flange were drawn in. The overhanging corner was filleted and was nailed under the runner and at points where the mold was broken. The mold was successfully cast without drying. The method of gating and the risers are shown in Fig. 2 and the sections of the loose flange and lug pattern are illustrated at *X*, Fig. 1.

Personal

F. W. Horrobin, for many years associated with the Waterbury Crucible Co., Waterbury, Conn., is now affiliated with the Chicago Fire Brick Co., Chicago.

Chas. J. Mesta, vice president of the Mesta Machine Co., Pittsburgh, has resigned to become president and general manager of the Hubbard Steel Foundry Co., East Chicago, Ind.

W. M. Carpenter, formerly associated with the Marion Malleable Iron Works, Marion, Ind., has been appointed general manager of the Kuebler Foundries, Inc., Easton, Pa.

Urban W. Frink, formerly with the C. E. Mills Oil Co., Syracuse, N. Y., in the capacity of salesman in the New England territory, is now associated with the General Motors Co., Detroit.

C. E. A. Thompson, formerly connected with the Bridgeport Foundry & Machine Co. and the Bridgeport Deoxidized Bronze & Metal Co., Bridgeport, Conn., is now connected with the Millet & Harley Co., Springfield, Mass., in the capacity of sales manager.

Walter B. Snow, publicity engineer, 170 Summer street, Boston, has increased his organization by the addition of Chas. Mulligan, late of the editorial staff of the *Brooklyn Standard Union* and for a considerable period associated with the publicity department of the Western Electric Co.

A Quick-Detachable Grab Bucket

The Whiting Foundry Equipment Co., Harvey, Ill., has obtained the exclusive right to manufacture the Watters quick-detachable grab bucket, which can be handled by a crane by merely inserting the crane hook into the yoke to which the operating ropes are attached. Lowering the crane hook sets the latch mechanism and raising the hook closes the blades and grabs the load. The contents are dumped by pulling the hand rope attached to the latch lever, which can be controlled by the crane operator or from the floor. In Fig. 1 the bucket is shown in open position ready for filling and in Fig. 2 the bucket is closed and contains a load of sand.

All shock, either to the crane or bucket, when emptying the load, is absorbed by a special, cylinder-operating device. The bucket can be operated underneath a minimum of headroom and a new arrangement, which is now being designed, will permit of its operation in even a smaller space than indicated in the accompanying illustrations. When not in use the bucket can be quickly detached, leaving the crane hook free for other service. This bucket will prove of great value in foundries, where it can be employed for clearing floors, cutting sand, filling large molds, transferring sand from shaking-out to molders' floors and for removing refuse. It also can be employed efficiently for loading and unloading coal, coke, clay, crushed stone, gravel, etc. On large jar-ramming molding machine work this bucket can be employed for filling the flasks, thereby eliminating the shoveling of large quantities of sand by hand. Molding operations can be greatly facilitated and the number of laborers usually employed for this work can be greatly reduced. A bucket of two cubic yards capacity operating under actual shop conditions recently unloaded 40 tons of sand from a gondola car in 20 minutes, the only manual labor employed being that of the crane operator. This bucket is built in three sizes, in 1, 1½ and 2-cubic yard capacities.

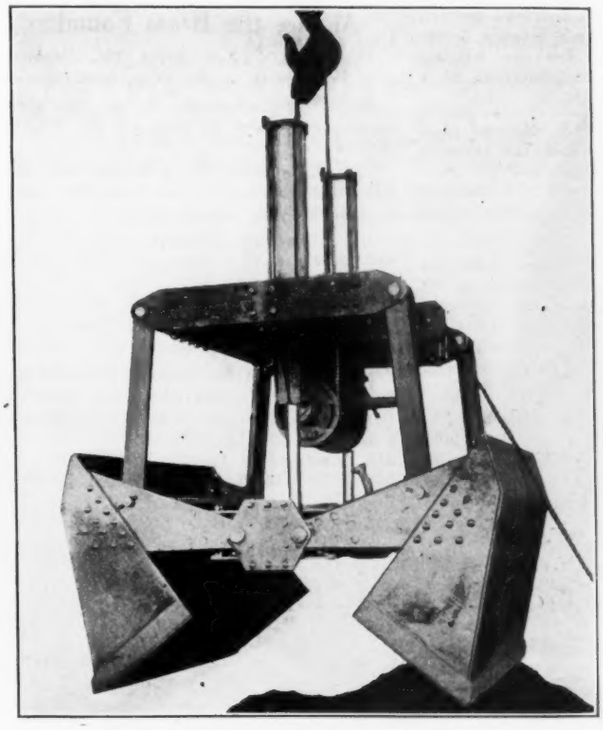


FIG. 1—QUICK-DETACHABLE GRAB BUCKET IN OPEN POSITION

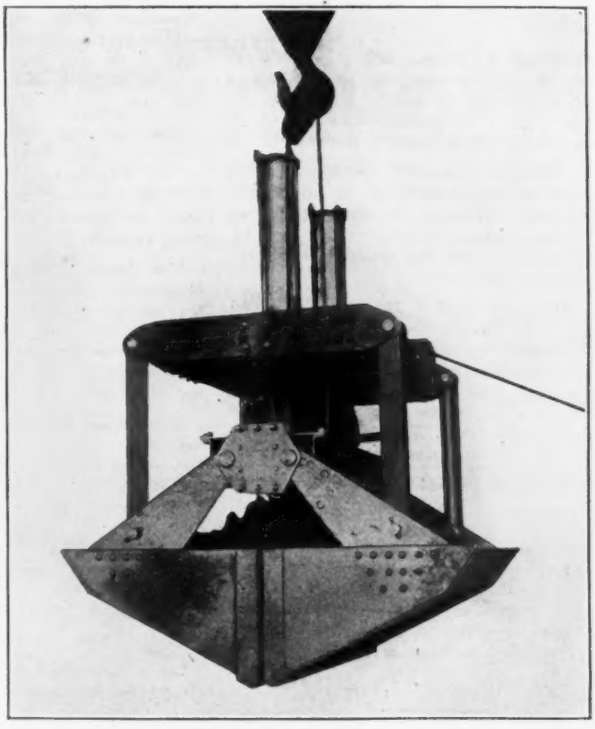


FIG. 2—QUICK-DETACHABLE GRAB BUCKET IN CLOSED POSITION

A process for soldering aluminum, recently patented in Switzerland, employs as a flux the following composition: Potassium chloride, 50 parts; calcium chloride, 30 parts, and cyrolite, 6 parts. The flux is made by melting the component parts together and when thoroughly cool, the mass is pulverized. The resulting powder is sprinkled on the parts to be soldered and is fused by the heat applied during the operation.

GENERAL INDUSTRIAL NOTES

The Vulcan Iron Works Co., Toledo, O., has been incorporated with a capital of $10,000 to operate a foundry and machine shop.

The Marion Iron & Brass Bed Co., Marion, Ind., has changed its name to the Harwood-Bailey Mfg. Co.

The Lexington Foundry & Machine Co., Lexington, Tenn., has been incorporated with a capital of $10,000 to take over the plant of the Lexington Machine Co.

The Mulberry Foundry & Mfg. Co., Mulberry, Fla., has been incorporated with a capital of $100,000 by C. C. Martin, A. B. Hull Jr., W. F. Walker and J. M. Langford.

The Texas Foundry & Machine Co., Dallas, Texas, has been incorporated with a capital of $10,000. The incorporators are E. B. Holland, J. H. Durkee and R. W. Marple.

The Peterborough Model Foundry & Mfg. Co., Peterborough, Ont., has been incorporated with a capital of $40,000. The incorporators are T. H. Ruble, J. Condon and W. H. Pethie.

The George F. Shevlin Mfg. Co., Saratoga Springs, N. Y., has been incorporated with a capital of $600,000 to operate a foundry and machine shop. The incorporators are G. F. Shevlin, C. B. Kilmer and T. Kerley.

The National Malleable Castings Co. is contemplating the installation of an electric steel melting furnace in its plant at Sharon, Pa. Three open-hearth furnaces are now being operated to meet the requirements of the steel foundry department.

The Maryland Mold & Foundry Co., Cumberland, Md., has recently been incorporated and has taken over the business of the Maryland Foundry Co. and the Potomac Mold & Machine Co. This concern makes a specialty of gray iron castings. The officers of the new corporation are I. W. Holmes, president, and H. W. Fielding, treasurer and manager.

The Worcester Pressed Steel Co., Worcester, Mass., is completing a foundry, 21 x 31 feet. This company makes a specialty of cold seamless hollow drawing, pressing, coining, embossing and stamping patterns for sheet steel, brass, copper, aluminum, silver and other sheet metals. The officers of the company are J. M. W. Higgins, president and treasurer and Arthur P. Higgins, secretary.

New Construction

The Gartshore-Thompson Co., Hamilton, Ont., will erect a new foundry.

The Ferro Machine & Foundry Co., Cleveland, is having plans prepared for a new foundry and machine shop.

The Greenlee Foundry Co., 662 West Twelfth street, Chicago, will shortly begin the erection of a new foundry.

Sheldons, Ltd., Galt, Ont., will erect a new foundry, 110 x 200 feet. Two cupolas will be installed together with electric cranes. The machine shop will also be enlarged.

The Gerlinger Steel Casting Co., West Allis, Wis., has commenced work on an addition to its foundry, 24 x 75 feet, of frame and brick construction.

The Manitoba Bridge & Iron Works, Winnipeg, Man., will erect a new plant for the manufacture of gray iron and steel castings. Machine shops, forge shop and several other buildings also will be erected.

The Emerson-Brantingham Co., Rockford, Ill., will erect a new foundry of steel and concrete construction, which will adjoin the main plant and will take the place of the present No. 2 foundry.

The Worcester Pressed Steel Co., Worcester, Mass., is completing the erection of a foundry, 21 x 31 feet, which is to be used for the manufacture of steel and semi-steel castings.

The Tulsa Stove & Foundry Co. will locate its new plant at Sand Springs, Okla. The building will be 40 x 250 feet, including a foundry, 40 x 130 feet. The remainder of the building will be used as a nickel-plating plant and mounting department.

The A. L. Swett Iron Works, Medina, N. Y., will erect a new foundry which will cover an area of about 35,000 square feet. Traveling and jib cranes will be installed, in addition to a 6-inch cupola, core ovens and other foundry equipment.

The plant of the Wyandotte Foundry Co., Wyandotte, Mich., recently destroyed by fire, will be rebuilt and will have a capacity double that of the old foundry. The new building will be of brick and steel construction, 83 x 140 feet.

The Talladega Foundry & Machine Co., Talladega, Ala., has purchased the property of the Talladega Lumber Co. and its plant will be removed to this site. A soil-pipe shop and steel foundry for making small steel castings will be built.

The Atlantic Radiator Co. has closed its foundry at Huntingdon, Pa., temporarily, for the purpose of making repairs and extensive improvements. A new core room, 60 x 80 feet, will be built and an I-beam trolley will be installed to connect the core shop with the foundry.

The Wilson Steel Range Co., Belleville, Ill., has been incorporated with a capital of $50,000. A new plant will be erected, which will include a foundry for the manufacture of stove plate. The incorporators are James Wilson, Gottlieb Klemme, Wm. Schlott, J. A. Schwartz Jr., and James A. Sutherland.

The North Buffalo Hardware Foundry, Buffalo, recently organized, has under course of construction a new foundry, 230 x 66 feet. Molding machines will be installed. The officers of the company are W. A. Griffin, president; E. B. McKenna, vice president, B. H. Prentice, treasurer, and L. F. Gilbert, secretary.

The Western Implement & Motor Co., Davenport, Ia., will erect a new plant for the manufacture of agricultural implements. The works will consist of a main building, 80 x 1,000 feet; foundry, 80 x 500 feet; machine shop, 60 x 500 feet; grinding room and foundry storage, 80 x 500 feet, and other structures such as the office building, power plant, blacksmith shop, etc. The main building, office and foundry will be the first units to be completed.

Among the Brass Founders

The C. O. Clark Brass Co., Montreal, Que., will equip a new brass foundry.

The Comstock-Wellman Bronze Co., Cleveland, has changed its name to the Wellman Bronze Co.

The Allyne Brass Co., Cleveland, will make large additions to its plant and will install considerable new equipment.

The Aluminum Castings Co., Cleveland, will shortly erect a three-story brick addition to its foundry on Chene street, Detroit.

The Buckeye Aluminum Co., Wooster, O., will erect a new foundry. The building will be of brick construction.

The United States McAdamite Metal Co., Brooklyn, N. Y., has purchased a site in Detroit on which an aluminum foundry, 90 x 150 feet, will be erected. This new plant will be located at Isabella and E streets and will be a branch of the plant operated at Brooklyn.

Trade Publications

IRON CEMENT.—The application of iron cement for use in repairing cracks and leaks in concrete walls, floors, roofs, etc., for making them impermeable to moisture and also fireproof, is described in a 28-page booklet, issued by the Smooth-On Mfg. Co., Jersey City, N. J. Numerous sketches are included showing the methods of applying this cement for various purposes.

FOUNDRY EQUIPMENT. — Two handsomely-illustrated catalogs devoted to foundry equipment have been issued by Alfred Gutmann, Hamburg, Germany. One is devoted almost entirely to sand blast machines and equipment which are adapted for iron, steel and non-ferrous metal castings. Molding machines are described in another catalog, which shows the equipment for molding sanitary ware used in many German shops.

CRUCIBLES.—A 16-page booklet devoted to crucibles and other graphite products, which also contains a list of prices, has been issued by the Joseph Dixon Crucible Co., Jersey City, N. J. A list of standard sizes of crucibles is included, as well as general hints for the use of graphite pots in coke-fired and oil-burning furnaces. An interesting description is given of bottom-pour crucibles, which can be used to advantage for castings requiring unoxidized metal. Descriptions and prices of crucibles, crucible covers, stirrers, skimmers and dippers, retorts, etc., are included.

UNIVERSAL WOODWORKING MACHINE.—The Crescent Machine Co., Leetonia, O., is sending to the trade an 18-page illustrated catalog, devoted to its universal wood-worker and attachments. This machine is a combination band saw and circular saw, so constructed that either saw can be used independent of the other. It is self-contained and is arranged so that both saws are driven from one main belt from the line shaft. The machine has two drive shafts, but no separate countershaft. The drive shafts are located in the base of the machine, leaving a clear floor space all around for the more convenient handling of lumber. The base is a single casting, and it is provided with casters, which are raised or lowered by a set of screws. The floor space occupied is considerably less than is required by individual machines, the expense of belting is reduced and countershafting is eliminated. The special attachments comprise band saw guards, re-sawing gages for splitting or re-sawing boards edgewise, jointer, shaper, tenoner, dado head, borer, and knife and disc grinders.